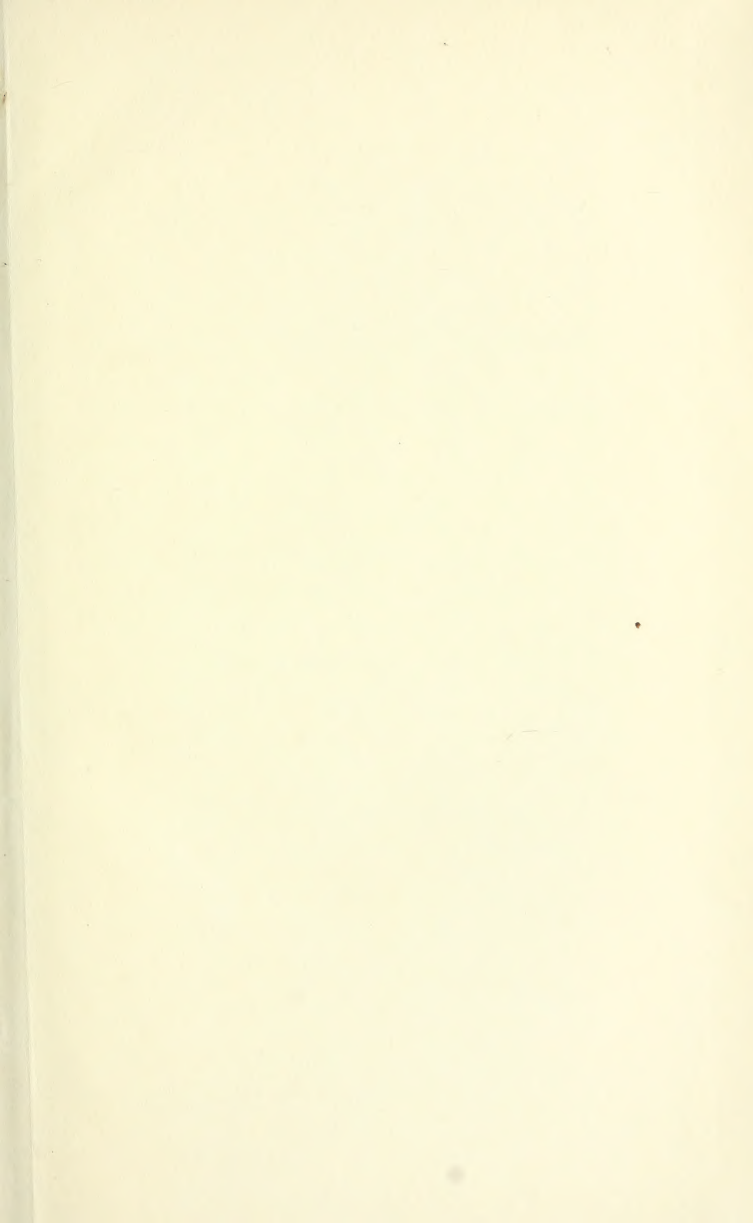


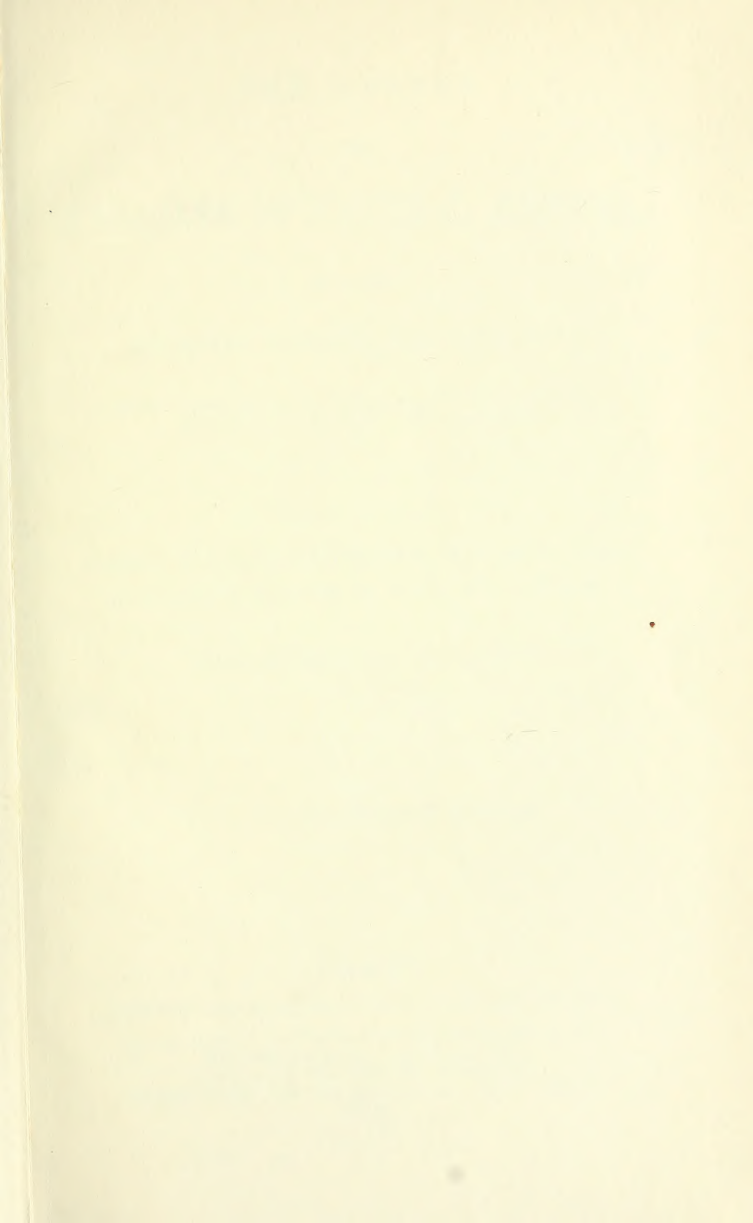
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THE ANNALS
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MAGAZINE OF NATURAL HISTORY,

INCLUDING
ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND
CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')
13

CONDUCTED BY
ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.R.S.
WILLIAM CARRUTHERS, F.R.S., F.L.S., F.G.S.,
AND
WILLIAM FRANCIS, Ph.D., F.L.S.

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VOL. XVIII.—SIXTH SERIES.  
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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper aestimata; à verè eruditis et sapientibus semper exulta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

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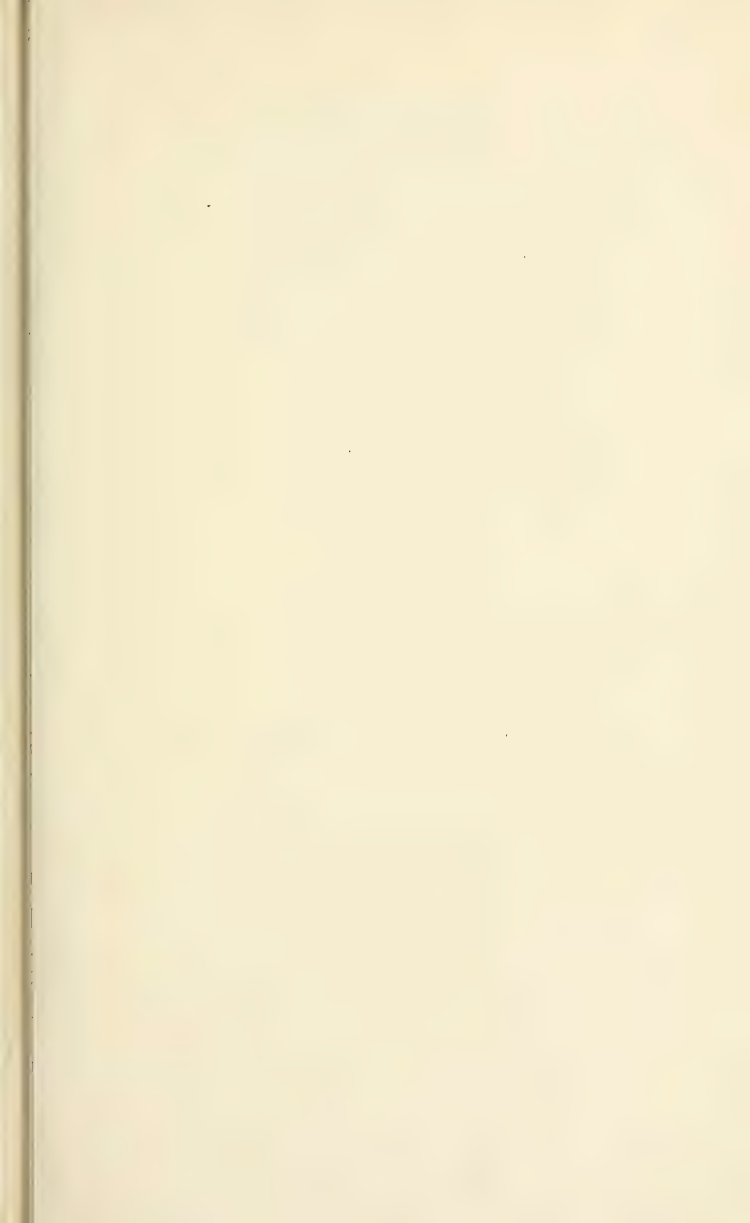
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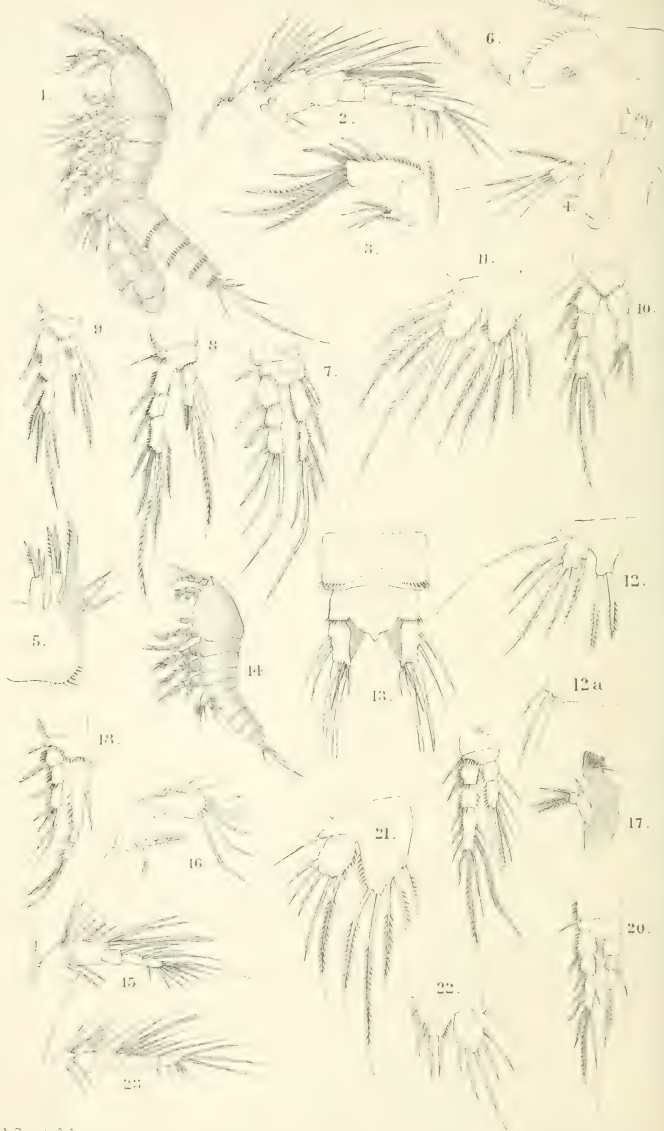
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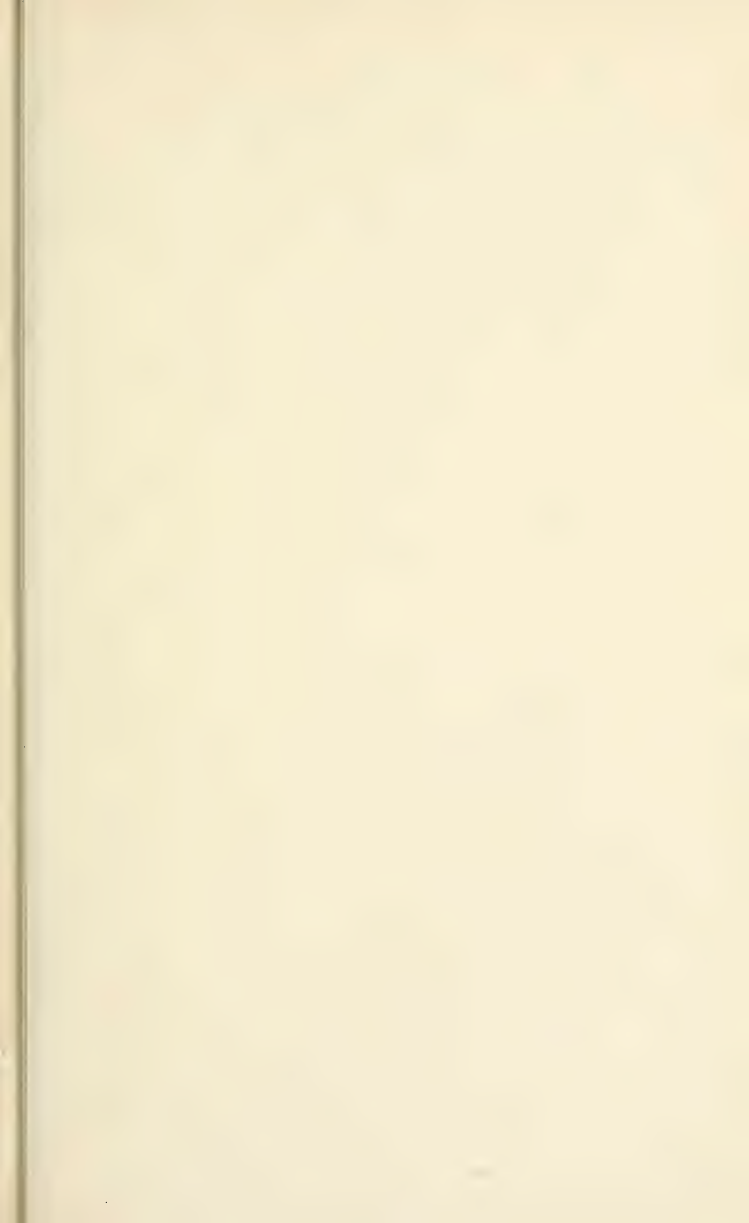


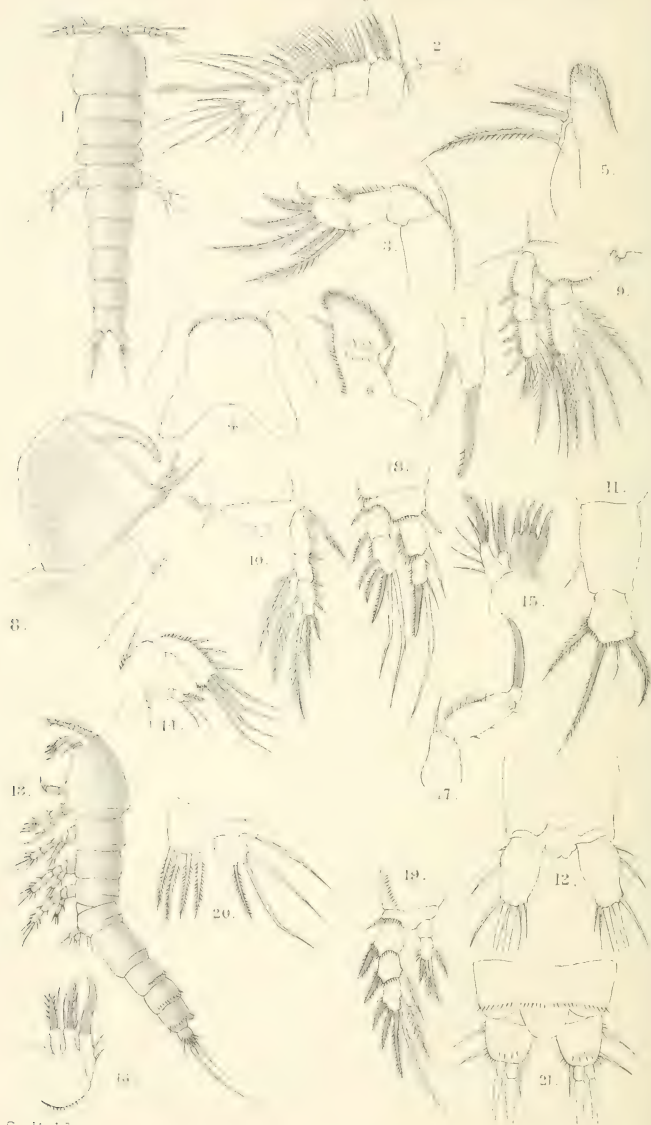
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Figs 1-13. *Attheyella Duthiei*. sp. n. Figs 14-22. *Canthocamptus parvus*. sp. n.

Fig. 23. *Maraenobiotus Vejdovskyi*. Mrazek.





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Figs. 1-12. *Clausia Cluthæ*. sp. n.
Figs. 13-21. *Maraenobiotus Vejdovskyi*, Mrazek.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

"..... per litora spargite muscum,
 Naiades, et circum vitreos considite fontes:
 Pollice virgineo teneros hic carpite flores:
 Floribus et pictum, divæ, replete canistrum.
 At vos, o Nymphæ Craterides, ite sub undas;
 Ite, recurvato variata corallia trunco
 Vellite muscosis e rupibus, et mihi conchas
 Ferte, Deæ pelagi, et pingui conchyliis succo."
N. Parthenii Giannettasi, Ecl. 1.

No. 103. JULY 1896.

I.—*On some new and rare British Crustacea.* By THOMAS SCOTT, F.L.S., Mem. Soc. Zool. de France, Naturalist to the Fishery Board for Scotland, and ANDREW SCOTT, Fisheries Assistant, University College, Liverpool.

[Plates I. & II.]

Genus *CLAUSIA*, Claparède * (1863).

(?) *Clausia Cluthæ*, sp. n. (Pl. I. figs. 1–12.)

Description of the Species.—*Female.* Length 1·3 millim. ($\frac{1}{19}$ of an inch). Body narrow, elongate, tapering gradually towards the posterior end. Antennules (fig. 2) short, stout, six-jointed, and moderately setiferous; there is not much difference in the length of the first, second, third, and last joints, except that the first is rather longer than the other three; the fourth and fifth joints are also subequal, but they are both shorter than any of the other joints, as shown by the formula—

Proportional lengths of the joints..	16	13	12	8	7	13
Number of the joints	1	2	3	4	5	6

* Not *Clausia*, Boeck (1864); as Claparède had already used this name, M. Boeck, in 1872, substituted the name *Pseudocalanus* for his genus.

Antennæ stout, three-jointed, middle joint considerably shorter than the first or third; no secondary branch (fig. 3). Mandibles simple, lamelliform, tapering towards the rounded ciliated apex and furnished with three stout plumose marginal setæ of unequal length (fig. 5). The maxillæ consist each of an oblong lamelliform appendage, the extremity of which is obliquely truncate, slightly rounded, and fringed with cilia (fig. 6). Anterior foot-jaws simple, one-jointed, armed with a stout elongate spine at the apex in addition to a smaller spine on the inner margin (fig. 7). The posterior foot-jaws form powerful grasping-organs; they are each two-jointed, with the joints short and very robust; the end-joint terminates in a broadly truncate extremity, to the posterior half of which is articulated a strong slightly curved claw; the anterior angle is lengthened into a stout tooth-like process, against which the claw impinges, as shown by the drawing (fig. 8). The first and second pairs of feet are somewhat similar in structure; the outer branches are three-jointed and the inner two-jointed; the exterior distal angles of the first and second joints of the outer branches are each furnished with a moderately stout spine, while the third joint bears four spines round the outer margin and apex and three long plumose setæ on the inner margin; the second joint of the inner branches bears three plumose setæ round the inner margin and apex and a small apical spine; a long plumose seta also springs from the inner margin of the first joint; the outer branches are only slightly more elongate than the inner branches (fig. 9). The third and fourth pairs of feet are also nearly alike in structure, but differ considerably from the first and second pairs; each of the third and fourth pairs is composed of a three-jointed outer branch and an almost obsolete one-jointed inner branch; the small rudimentary joint of which the inner joint consists possesses apparently neither seta nor spine (fig. 10). Fifth pair large and prominent and composed of a single two-jointed branch; the end-joint, which is much shorter than the other, is furnished with three moderately stout and plumose terminal setæ, the middle one being considerably longer than the other two (fig. 11). Caudal stylets equal to about half the length of the last abdominal segment (fig. 12).

Habitat. Ayr Bay, Firth of Clyde. Among trawl-refuse; one specimen.

Remarks. Though the species now described was obtained among some trawl-refuse unattached to any other organism, it is apparently a parasitic form of some kind; the structure of the antennæ and the simple form of the mandibles and

maxillæ, combined with the remarkably powerful posterior foot-jaws and fifth pair of feet, are fairly satisfactory evidence of its parasitic habits. This species, if not congeneric with Claparède's genus *Clausia*, is at least very closely allied to it, and therefore till further specimens, especially male, be obtained, to permit of a more thorough examination being made, we prefer meanwhile to place it in that genus.

(?) *Clausia Cluthæ* somewhat resembles *Clausia Lubbockii*, Claus, in general appearance; but the difference in the structure of the antennules and fifth pair of feet distinguishes it at once from that species.

Maraenobiotus Vejdovskyi, Mrazek.

(Pl. I. figs. 13-21; Pl. II. fig. 23.)

This curious freshwater Copepod was described for the first time by Herr Al. Mrazek in the seventh volume of the 'Zoologische Jahrbücher' (1893), p. 103, Taf. iv. figs. 17-32, and Taf. v. figs. 33-37. The following brief description (with drawings) is prepared from Scotch specimens:—

Female. Length .67 millim. ($\frac{1}{57}$ of an inch). Body slender and elongate (fig. 13), and in this respect somewhat similar to *Ophiocamptus*. Antennules short, eight-jointed (Pl. II. fig. 23). Secondary branches of antennæ two-jointed, the end-joint shorter than the other (Pl. I. fig. 14). Both branches of the first pair of swimming-feet two-jointed and nearly of equal length (fig. 18). Inner branches of the next three pairs two-jointed and considerably shorter than the three-jointed outer branches (fig. 19). Fifth pair small; inner portion of the basal joint not much produced, broadly truncate and furnished with four moderately short and subequal plumose setæ on the margin of the truncate apex; secondary joint very small, ovate, and provided with three terminal setæ, the inner one somewhat like those on the basal joint, the other two subequal and fully twice as long (fig. 20). Caudal stylets short and stout; the principal seta of each stylet is articulated at the base and dilated, as shown in the drawing (fig. 21).

Habitat. Loch Vennachar, Perthshire; not very common.

Remarks. This species, which is an addition to the British fauna, is readily distinguished from other British Harpacticids by the structure of the first pair of swimming-feet, both branches of this pair being two-jointed; the mandibles, maxillæ, and foot-jaws resemble those of *Canthocamptus*, except that the mandible-palp is rudimentary and represented by a few setæ that spring from a papilliform lateral process.

The rudimentary character of the mandible-palp, together with the two-jointed outer branches of first pair of feet, separate *Maraenobiotus* distinctly from any other genus of the freshwater Harpacticidæ. We have not been able to give a figure of the mandible-palp, and therefore quote the following reference to it from Herr Al. Mrazek's description. He says:—"Als ein wichtiger Charakter muss hervorgehoben werden, dass der Mandibularpalpus sehr rückgebildet ist, nämlich nur durch einen kleinen drei schwache Borsten tragenden Höcker repräsentirt wird."

Attheyella Duthiei, sp. n. (Pl. II. figs. 1-13.)

Description of the Species.—*Female*. Length .9 millim. ($\frac{1}{28}$ of an inch). Posterior margins of the second to the fifth thoracic segments serrulated; the abdominal segments have a fringe of cilia posteriorly; rostrum of moderate length (fig. 1). Antennules short, eight-jointed; the first two joints are more dilated than the others and the fifth and seventh are somewhat shorter; the approximate proportional lengths of the joints are shown by the formula—

Proportional lengths of the joints..	16	16	13	12	10	13	9	13
Number of the joints	1	2	3	4	5	6	7	8

The antennules are moderately setiferous and bear a short sensory filament at the upper angle of the fourth joint (fig. 2). Antennæ stout, two-jointed; the secondary branch consists of a single comparatively slender and elongate joint, which is furnished with a few setæ at the distal end (fig. 3). The mandibles have the biting-part armed with two or three lamelliform plates slightly notched at the apex; the mandible-palp has the basal portion moderately stout, to which is articulated near the distal end a single one-jointed setiferous branch (fig. 4). Maxillæ and first and second foot-jaws somewhat similar to those of *Canthocamptus hirticornis*, T. Scott. The inner branches of the first pair of swimming-feet, which scarcely reach beyond the end of the outer branches, are composed of two joints of nearly equal length, but the end-joint is much more slender than the other; the first joint bears a short plumose seta near the distal end and the second joint a similar seta near the middle of the inner margin, while the inner and outer margins of both joints are more or less fringed with cilia; in the second joint the middle one of the three terminal setæ is very long and slender, the inner one is very short and plumose, while the outer is elongate, slender, and somewhat claw-like; the outer branches, which are com-

posed of three nearly equal joints, are armed with moderately long marginal spines, the outer margins of all the joints being also fringed with cilia (fig. 7). In the next three pairs the inner branches, which are also composed of two subequal joints, are much shorter than the outer branches; the outer three-jointed branches are elongate, and the principal terminal seta in both branches is very long and slender (fig. 8). In the fifth pair the inner portion of the basal joint is broadly subtriangular and bears about six elongate setæ of unequal length round the apex; the secondary joint is broadly ovate and furnished with two setæ on the outer margin and three at the end, the middle one of the terminal three is extremely long and slender, the inner margin is ciliated (fig. 11). Caudal stylets about equal in length to the last abdominal segment (fig. 13).

The male antennules form powerful grasping-organs. The second pair of swimming-feet differ somewhat from those of the female in that the first joint of the inner branches is armed with curved tooth-like processes, as shown in the drawing, and the marginal spines of the first and second joints of the outer branches are much stouter than those of the same joint in the female (fig. 9). The end-joint of the inner branches of the third pair in the male terminates in two moderately long and slightly curved processes, which are of nearly equal length; a small plumose seta also springs from near the base of the terminal processes (fig. 10). The male fifth pair are small, the inner produced part bears two stout, moderately long, and spiniform terminal setæ; the secondary joint is furnished with five setæ arranged as shown by the drawing (fig. 12). The first abdominal segment is furnished at the outer distal angle on the ventral aspect with three setæ (fig. 12 a).

Habitat. Brough Loch, Island of Yell, Shetland.

Remarks. This species somewhat resembles *Ophiocamptus brevipes* (G. O. Sars), but in that species the antennules are seven-jointed, the end-joint of the inner branches is shorter than, but nearly as stout as, the first joint, and the secondary joint of the fifth pair is considerably narrower; there is also some difference in the structure of the mandible and in the length of the caudal stylets. It is interesting, however, to observe an oval pellucid area on the dorsal surface of the cephalic segment, similar to that shown in the drawing of *Ophiocamptus brevipes* by Herr Al. Mrazek*. As we do not

* "Beitrag zur Kenntniss der Harpacticidenfauna des Süsswassers," Zoologische Jahrbücher, siebenter Band, p. 116, pl. v. fig. C6, pl. vi. figs. 67-70.

know of any described species similar to this Shetland form we have named it in honour of Mr. Duthie, Fishery Officer, Shetland; it is because of his interest and zeal for natural history work that we have been able to add considerably to the knowledge of the freshwater Crustacea of the Shetland Islands.

(?) *Canthocamptus parvus*, sp. n.
(Pl. II. figs. 14-22.)

Description of the Species.—Female. Length .37 millim. ($\frac{1}{70}$ of an inch). Body moderately stout; antennules short, six-jointed; the first three joints subequal and robust, the last three also subequal, but considerably smaller than the first three (fig. 15). Secondary branch of the antennæ unarticulate, very small, and bearing a short plumose terminal seta (fig. 16). Mandible-palp small; basal joint moderately stout, bearing at the obliquely truncate end a very small one-jointed branch, which is furnished with three short plumose setæ (fig. 17). Other mouth-organs similar to those in typical *Canthocamptus*. The first pair of swimming-feet somewhat resemble those of *Canthocamptus trispinosus*; the first joint of the inner branches is rather longer than the entire length of the outer branches; the second and third joints are together equal to about half the length of the first joint, but the second is rather shorter than the third; the third joint bears two terminal setæ, one short and spiniform, the other about twice the length and more slender; a short seta springs from near the middle of the inner margin of the first joint; there are also a few minute setæ on the outer margins of all the joints (fig. 18). The inner branches of the next three pairs are short and composed of two nearly equal joints; outer branches elongate, three-jointed, the end-joint rather longer than either of the other two (fig. 19). Fifth pair small, inner portion of the basal joint broadly foliaceous, apex obliquely truncate and bearing five setæ of unequal length; four of them are moderately short, and one (the second from the outside) more elongate; secondary joint subquadrangular, rather longer than broad, and furnished with five small apical setæ, the two innermost of which are longer than the others (fig. 21). Caudal stylets very short.

Male. The male differs little from the female except that the antennules are apparently eight-jointed and of a complicated hinged structure adapted for grasping. The inner branches of the third pair of swimming-feet in the male are three-jointed and rather longer than the inner branches of the

same pair in the female; the second joint bears a small seta on the inner angle and the last joint is furnished with two terminal setæ (fig. 20). The male fifth pair are very small, the inner portion of the basal joint is somewhat triangular in form and carries three small apical setæ; the secondary joint is subrhomboid and provided with five setæ round the end, as shown in the drawing (fig. 22).

Habitat. Between tide-marks at Aberlady Bay, Firth of Forth.

Remarks. In *Canthocamptus* the antennules are usually eight- or nine-jointed, but in the small species now described they are only six-jointed, and the secondary branches of the antennæ are uniaarticulate and almost rudimentary; but in other respects it possesses all the characters of a typical *Canthocamptus* according to the present definition of that genus.

We have pointed out elsewhere* that from the great variation in the structural details of the species of which the genus *Canthocamptus* is composed a revision of the genus will ere long be necessary; when that is done, it may be found expedient to remove the species now described into another genus; but meanwhile the genus *Canthocamptus* appears to be the only group of the Harpacticidæ to which it can be allocated.

EXPLANATION OF THE PLATES.

PLATE I.

(?) *Clausia Cluthæ*, sp. n.

Fig. 1. Female, dorsal view, $\times 40$. 2. Antennule, $\times 170$. 3. Antenna, $\times 253$. 4. Mouth, $\times 500$. 5. Mandible, $\times 500$. 6. Maxilla, $\times 500$. 7. Anterior foot-jaw, $\times 760$. 8. Posterior foot-jaw, $\times 253$. 9. Foot of first pair of swimming-feet, $\times 170$. 10. Foot of fourth pair, $\times 170$. 11. Foot of fifth pair, $\times 127$. 12. Last abdominal segment and caudal stylets, $\times 170$.

Maraenobiotus Vejdovskýi, Mrazek.

Fig. 13. Female, side view, $\times 80$. 14. Antenna, $\times 380$. 15. Maxilla, $\times 380$. 16. Anterior foot-jaw, $\times 380$. 17. Posterior foot-jaw, $\times 380$. 18. Foot of first pair of swimming-feet, $\times 253$. 19. Foot of fourth pair, $\times 253$. 20. Foot of fifth pair, $\times 380$. 21. Last abdominal segment and caudal stylets, $\times 253$.

PLATE II.

Attheyella Duthiei, sp. n.

Fig. 1. Female, side view, $\times 50$. 2. Antennule, $\times 253$. 3. Antenna

* Ann. Scot. Nat. Hist., Oct. 1895.

× 253. 4. Mandible, × 380. 5. Anterior foot-jaw, × 380. 6. Posterior foot-jaw, × 380. 7. Foot of first pair of swimming-feet, × 170. 8. Foot of fourth pair, × 170. 9. Foot of second pair (male), × 170. 10. Foot of third pair (male), × 170. 11. Foot of fifth pair, × 170. 12. Foot of fifth pair (male), × 253. 12*a*. Appendage of first abdominal segment. 13. Last two abdominal segments and caudal stylets, × 125.

(?) *Canthocamptus parvus*, sp. n.

Fig. 14. Female, side view, × 80. 15. Antennule, × 380. 16. Antenna, × 380. 17. Mandible, × 380. 18. Foot of first pair of swimming-feet, × 253. 19. Foot of fourth pair, × 253. 20. Foot of third pair (male), × 253. 21. Foot of fifth pair, × 380. 22. Foot of fifth pair (male), × 380.

Maraenobiotus Vejdoskýi, Mrazek.

Fig. 23. Antennule, × 253.

II.—*Notes on the Parasitic Copepoda of Fish obtained at Plymouth, with Descriptions of new Species.* By P. W. BASSETT-SMITH, F.Z.S., F.R.M.S., Surgeon R.N.

[Plates III.–VI.]

IN taking up this subject I am chiefly indebted to Prof. F. Jeffrey Bell, who suggested it to me as being likely to prove a fruitful and interesting investigation to fill up time while stationed at Plymouth. This I the more willingly did, having the kind assistance of the Director of the Marine Biological Association's Laboratory and others there, to whom I tender my best thanks. The greater part of the material was, however, obtained by daily and diligent search at certain fishmongers in the town.

Although there are many admirable monographs and treatises dealing with these curious and often *bizarre*-looking animals, they are chiefly of somewhat ancient date: the most important are:—

MÜLLER. 'Entomostraca.' 1785.

OTTO and BURMEISTER. 'Nova Acta Natur. Curios,' 1826. 1831.

KRÖYER. 'Naturhist. Tidsskrift,' 1838 and 1863.

MILNE-EDWARDS. Treatise, 'Crustacés,' tome iii. 1840.

NORDMANN. 'Mikrographische der wirbellosen Thiere.' 1832.

CLAUS. Monographs. 1860–1875.

CARL VOGT. 'Archives Zoologie expér.,' tome xvi. 1877.

CAMIL HELLER. "Crustaceen," Reise der Fregatte Novara.

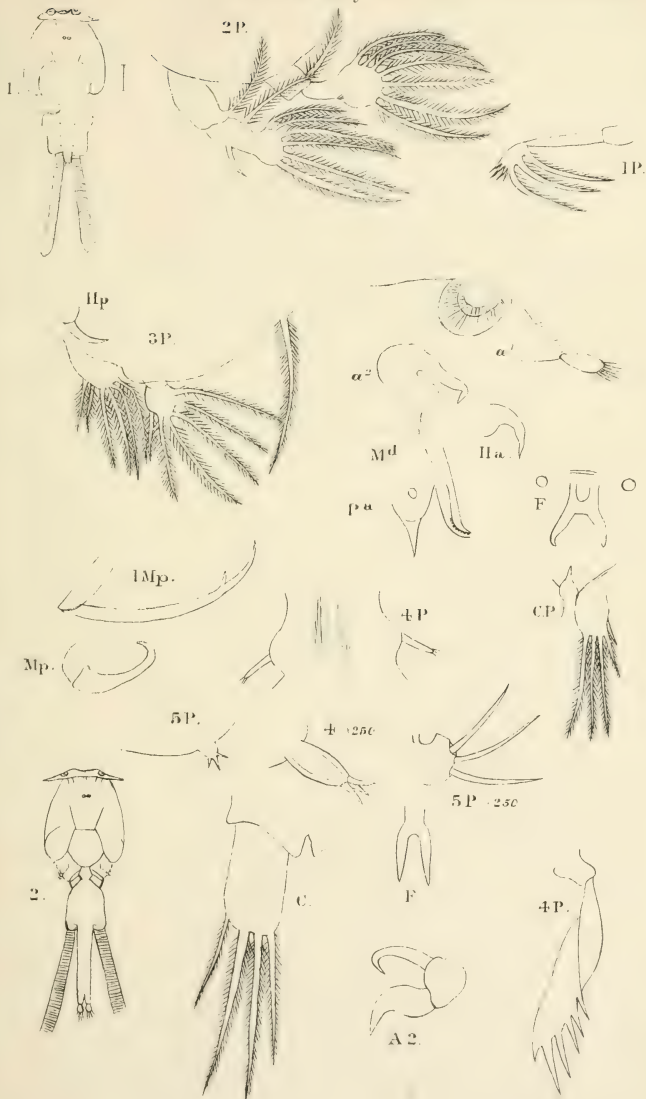
HESSE. Monographs. 1862–1868.

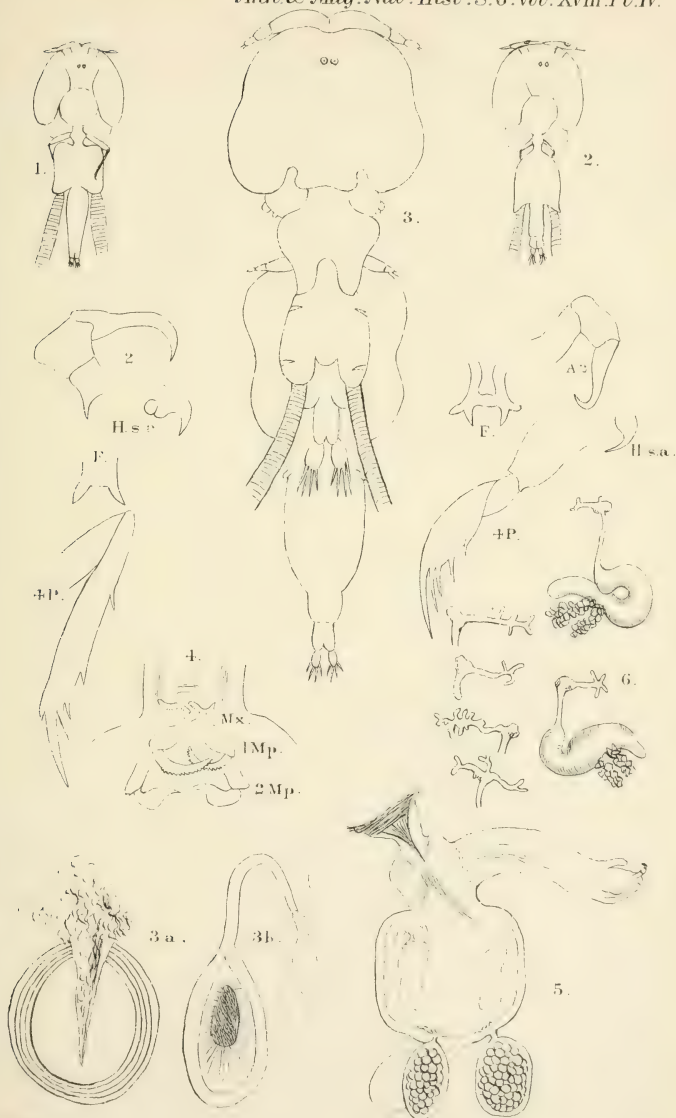
VAN BENEDEN. 'Note sur un Crustacé parasite nouveau, &c.' 1861.

BAIRD. 'British Entomostraca.' 1850.

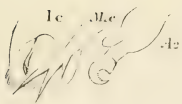
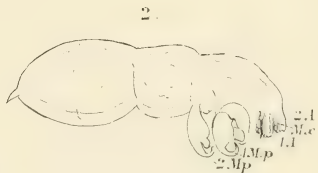
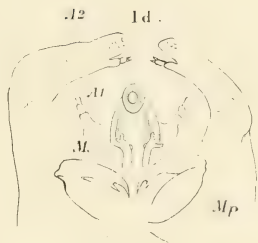
GERSTAECKER. "Copepoda," Bronn's 'Thierreich.'

KURZ. Monograph. 1877.









The literature being so scattered makes the investigation difficult—all the more so as nearly every author has his own scheme of classification. I propose now to use that drawn up by Gerstaecker, which is founded more on the minute anatomy of the animals, and is the most recent, though that used by Dr. Heller in his great work is very admirable. A large number of the genera described by both these authors are, however, purely tropical and do not come within the scope of this paper. The most difficult to assign definite places to are the very much differentiated members of the family Lernæopodidæ, where I believe the character of the male is the only safe guide. I would specially point out that the distinction given separating the genera *Brachiella* and *Anchorella*, viz. the fusion of the second pair of maxillipeds partly or wholly, is not a reliable one. It would be much better to found these genera on the structure of the pigmy males, which are quite distinctive; but, unfortunately, these latter are not all known or figured.

From a collector's point of view one is quickly struck by the much greater susceptibility of some fish over others and the large number of parasites found on them individually. For instance, it is rare to find a fairly grown cod (*Gadus morrhua*) without being able to take many specimens of the small semitranslucent *Anchorella uncinata* attached to the folds about the lips and in the gill-cavity. In its mouth and on the palate will be seen frequently half a dozen specimens of *Caligus curtus*, on the gills, deeply imbedded, a *Lerneæ branchialis*, and on the body sore places where numbers of *Caligus Mülleri* have been fixed. Again, one is almost certain in a hake (*Merluccius vulgaris*) on opening the mouth to find one or more specimens of *Chondracanthus merluccii* firmly fixed to the tongue, floor of the mouth, or palate, generally surrounded by mucus. In one case I removed thirty-three from the palate of a fish, leaving a raw ulcerated surface behind. The hake has two other fixed parasites attached to the gills—*Brachiella insidiosa* and *Brachiella merluccii*,—both fairly abundant.

All the Gadidæ seem to be infested.

The Gurnard family, too, are very prolific both in variety and number of specimens; but it is generally only in the well-grown fish that the parasites are found, these being *Caligus rapax*, *Caligus diaphanus*, *Brachiella impudica*, and *Brachiella bispinosa*.

Tucked away in the anterior angle of the gills of *Zeus faber* will almost certainly be found on either side one specimen

of *Chondracanthus zeii*, which, from its large size, would seem to be at least inconvenient to its host.

The gills of the turbot and brill are frequently crammed with *Lepeophtheirus Thompsoni* and *Lepeophtheirus obscurus* (?) and so on, each fish having apparently in its adult stage one or more parasitic Copepoda.

After the examination of a great number of fish harbouring these parasites I believe that in the great majority of cases their presence is not prejudicial to the life of the fish, seemingly causing neither irritation nor destruction of tissue, for the following reasons :—

- (1) The fish bearing them were generally mature.
- (2) There were rarely any ulcerated surfaces found around or near their attachment.
- (3) The individual fish were generally well nourished.

There are, however, certain exceptions to this absence of prejudicial effect on the host.

(1) *Lernæa branchialis* and its allies, whose bodies are full of sanguineous fluid. The head and cephalic processes, deeply imbedded in a cysted clot of blood in and around the gills, must be a constant source of drain of nourishment and also cause great irritation to the hosts. Very frequently, however, one came across the remains of their chitinous necks still imbedded, from which the bodies had fallen away.

(2) A second, which certainly causes much irritation to the fish, is *Chondracanthus merluccii*, which, though surrounded by mucus and probably living on mucus, causes great destruction of the membrane where it is attached, as already mentioned. The other species of *Chondracanthus* apparently are not so troublesome, so far as I have seen.

(3) All species of *Lernæocera*, *Lernæonema*, and *Penella* must be harmful.

I do not, however, mean to infer that weakly and diseased fish are not more likely to suffer from these parasites, but that they are plentiful in those apparently healthy.

The curious attached condition of the young of the Caligidæ has been much noticed, being by Burmeister, Milne-Edwards, Krøyer, and Baird regarded as a separate genus, *Chalimus*; but their true nature is very well shown in the able monograph by Hesse, 'Des moyen curieux de certains Crustacés parasites' (Paris, 1866), though I do not think his theory, "that the males in the interest of propagation fix themselves by this singular means (the frontal filament) to the females," is of much value, as these attached forms are not infrequently

found fixed on to animals of different families, as *Chondracanthus* and *Anchorella*; or even sometimes in great numbers I have taken them fixed on to the gill-rakers of the cod and gurnard and the fins of the sea-trout. In other cases one may find as many as six in various stages of development attached to the adult forms. At first the carapace is very narrow, with its apex at the place of attachment of the frontal filament, the thoracic portion being proportionately large, having the double eye near the centre. The anterior antennæ are quite free from the frontal lobes. The maxillipeds increase in size as the carapace broadens, and before becoming detached the animal closely resembles the form of the adult; but I have not yet found any with lunulæ on the frontal lobes, even in those taken associated with species of *Caligus*.

During the course of my observations the following new or noteworthy species have been obtained * :—

Caligus scomberi, sp. n. (Pl. III. fig. 2.)

I have been unable to place this with any recorded species, and have therefore named it after the fish it is taken from. It is found on the inner surface of the operculum of *Scomber scomber*. It much resembles *Caligus diaphanus* (Nordmann and Kröyer, not Baird); but the carapace is oval, instead of being rounded, and the abdomen is much longer.

Carapace oval, narrow in front; posterior antennæ with well-marked palp; second pair of maxillipeds small; furcula small, with simple elongated branches, hardly spreading; caudal plate large, with three long plumose setæ, and one smaller one placed rather far outside.

Caligus brevipedis, sp. n. (Pl. III. fig. 1.)

Two specimens of this curious form were taken in August from the gill-cavity of *Motella tricirrata*. It differs from all other described species in the rudimentary condition of the fourth pair of thoracic limbs. The same character was found in both specimens, therefore it could not be an abnormality.

Carapace small, as broad as long, but rather narrower anteriorly. Frontal plates well developed; lunulæ of moderate size; anterior border of basal joint of anterior antennæ fringed with fine hairs; second joint terminating in about ten small bristles. Posterior antennæ strongly hooked, palp on basal joint blunt; *hamulus subsidiarius anterior* acutely bent;

* For a complete list of the parasitic Copepoda found on fish at Plymouth see Journ. Marine Biol. Assoc. vol. iv. no. 2.

mandibles finely dentate on convex border; first maxilliped long, bifid at end, outer claw very long; second maxilliped small, with simple claw; maxillary palp long and sharp; furcula small, simple, with widely divergent branches. First peraeopods with three very long plumose setae on the inner border and four short bristles at end of last joint; second peraeopods bifid, each two-jointed, bearing very long plumose setae; third peraeopods bifid, each branch two-jointed; hamulus posterior well marked; fourth peraeopods almost rudimentary, represented by minute basal joint, three times as long as broad, terminating in three short simple bristles.

Genital segment nearly square, lobed at posterior angles, bearing a tubercle giving rise to three simple setae (representing five pairs of limbs?).

Abdomen small, slightly longer than broad; caudal plates of moderate size, bearing one short and three long plumose setae; ovarian tube long, straight.

Lepeophtheirus pollachius, sp. n. (Pl. IV. fig. 1.)

Both sexes taken in quantity from the palate and back of the tongue of *Gadus pollachius*, also from the gills of the ling, *Molva vulgaris*. This species is nearly allied to *L. Stromii*, Baird.

Carapace oval, rather wider posteriorly, in some specimens broader than long; fourth joint of the thorax large, diamond-shaped; genital segment oblong, nearly as large as the carapace, lobed posteriorly; abdomen as long as the thorax, tapering off towards its extremity. Posterior antennae large, strongly hooked; palp short, acute. Hamulus anterior small; furcula with short, divergent, simple branches; fourth pair of peraeopods very long and powerful. Male much smaller than female, with elongated carapace and very narrow genital segment. Abdomen distinctly divided into two segments and caudal plates very long.

In many instances the young forms in various stages of development were found attached by their thread-like filaments to the margins of the carapace, genital segment, and abdomen of the female.

Elytrophora brachyptera, Gerstaecker. (Pl. IV. fig. 3.)

From the gills of a large tunny, *Thynnus thynnus*, taken outside Plymouth, I obtained ten specimens of this species, five of each sex, all alive. These I watched for several hours in a bell-glass. They were very active, and the males were seen to attach themselves to the females in the positions

represented in Dr. Heller's work, firmly fixed by the hook-like posterior antennæ and second maxillipeds.

On removing them the spermatophores were seen attached by long tubes to the genital segments of the females. These were pyriform, with a thick chitinous covering, and, when broken off, thin thread-like spermatric filaments issued from the tube end, or, if the capsule was broken, poured out *en masse* (fig. 3, A and B). On the males which had not completed the act the capsules were seen distinctly in the sperm-ducts, but were absent from those which had been removed from females bearing them, so that they appear to be monogamous.

Lerneæ luscæ, sp. n. (Pl. IV. fig. 6.)

This animal was found only on the gills of the whiting pout, *Gadus luscus*, and was very common, as many as four being found on one fish. The whole head is surrounded by a clot of blood, the elongated horn being buried by the side of the gill-bone.

It is much smaller and more delicate than *Lerneæ branchialis*; the secondary and posterior curve of the body is much less marked; there are generally three horns behind the mouth, the posterior one being highly developed and often as long as the neck, many-branched at the end. A large number of specimens were taken, all of the same size and character; so that I feel justified in believing it to be a distinct species from the more widely distributed *Lerneæ branchialis*.

Chondracanthus clavatus, sp. n. (Pl. V. fig. 1.)

Found only on the gills of *Pleuronectes microcephalus*. The head is oval, with well-developed antennæ; thorax elongated and club-shaped, with no sign of constriction in the middle, as in *C. cornutus*, Müll., and *C. solea*, Kröyer. The posterior horns are of moderate length. The two pairs of thoracic limbs are small, and the male is like that of *C. cornutus*.

Chondracanthus triglæ, Blainville. (Pl. IV. fig. 4.)

(*C. assellina*, Linn.)

Plentifully taken from *Trigla gurnardus*, *T. cuculus*, and *T. hirundo*. The whole anterior portion of the head and so-called neck is buried in a fleshy mass in the substance of the gill, the thoracic portion only showing. The mouth and two pairs of maxillipeds are found at the base of this neck (Pl. IV. fig. 4). Male very like that of *C. cornutus*. The length of the neck-like portion of the head is very variable, sometimes

considerably greater than the whole length of the thorax, at others so short as to be scarcely visible. Both these conditions occur in the mature female, the small immature specimens often having long necks. The species described as *Chondracanthus gurnardi* is probably one of these peculiar forms with short necks.

Brachiella insidiosa, Heller. (Pl. VI. fig. 2.)

These were found attached to the gill-rays of the hake, *Gadus merluccius*, being fairly common. The female agrees very closely with that described by Heller (obtained from a species of *Gadus* in the Mediterranean), except that the arms are rather shorter and the cephalothorax is more acutely bent.

The male (Pl. VI. fig. 2) is large, 3 centim. long, being generally found fixed to the centre of the back. The anterior part of the cephalothorax bearing the antennæ and the mouth-organs is distinctly separated off from the body, the latter being distinctly segmented.

Anterior antennæ small, three-jointed; posterior antennæ large and stout, placed behind the anterior, four-jointed (?), bifid at the end, one branch being blunt and short, the other terminating in a small dentate hook. Maxillæ terminating in two sharp-pointed flail-like branches, bearing a small palp at the base. First maxillipeds with sharp acutely bent claw. Second maxillipeds with a short blunt claw meeting a conical tubercle.

Brachiella merluccii, sp. n. (Pl. VI. fig. 1.)

These animals are always found attached to the *points of the gill-rakers* of the hake, *Gadus merluccius*, and never attached to the gill-rays themselves, as *B. insidiosa*. Both were frequently found in the same fish, but their positions were never other than that noted.

Female.—Cephalothorax of moderate length, about equal to that of the genital segment, tapering towards the head, and bent forward in an obtuse angle. Head slightly widest in front, the arms (second maxillipeds) not quite so long as the cephalothorax, being united in the whole length by a thin membrane. Organ of attachment a chitinous cup with a short pedicel.

Genital segment fiddle-shaped, very thick, carrying posteriorly two pairs of elongated processes; a dorsal pair directed backwards and outwards, and a ventral pair rising on either side of an elongated filiform abdomen ("postabdomen," Gerst.),

these being directed backwards, outwards, and upwards, encircling the egg-sacs.

Head.—Anterior antennæ small, three-jointed, last joint terminating in a few small hairs. Posterior antennæ placed outside the latter, thick, chitinous, the end being bifid, having an outer blunt branch bearing small tubercles and an inner articulate branch terminating in minute setæ. Mandibles small. Maxillary palp foliaceous, four-lobed. First pair of maxillipeds strong, with a powerful, curved, slightly cheliform terminal claw; they are placed close behind the rostrum.

Male.—About 1 centim. long. Cephalothorax large, distinct from the body, which is indistinctly divided into five segments, bearing posteriorly two short, pointed, two-jointed processes. Anterior portion of the cephalothorax carrying the mouth-organs. Anterior antennæ three-jointed, with very fine setæ at the end of the last joint. Posterior antennæ much thicker, articulate, terminating in a short obtuse joint, with a second branch bearing a small dentate claw. Maxillæ bifid at the end, the branches being long and pointed; palp very small. Both pairs of maxillipeds large and cheliform. According to the present classification this species should be placed with the *Anchorella*, for in the female the second maxillipeds are short, also being united together in their whole length; but the peculiar *Brachiella* form of the male causes it to be placed in this genus.

Anchorella paradoxa, van Beneden. (Pl. V. fig. 2.)

Found in the gills of *Scomber scomber*, but rare. The species is, however, very characteristic, and the male is distinctive, but has not yet been described by any author.

Male.—Body globular; cephalothorax produced; anterior antennæ slender, three-jointed; posterior antennæ stouter, bifid at the end, the outer branch being twice the length of the inner, which is flattened. Maxillæ slender, long, bifid at the extremity. First maxillipeds very large, the basal joint being oval, strongly muscular, and terminating in a strong hook. Second maxillipeds long, narrow, stilt-like, with the end slightly enlarged, where is seen a minute hook.

Anchorella quadrata, sp. n. (Pl. IV. fig. 5.)

A few specimens were obtained of this species from a dragonet, *Callionymus lyra*, attached to the gill-rakers. The cephalothorax is much longer than the genital segment, which is almost quadrilateral. The egg-sacs are small and broad, oval in shape; between the two is seen the abdomen, which

is of extraordinary size for animals in this genus. First pair of maxillipeds placed close to the mouth, well developed; second pair short, opposite to the abdomen and at the base of the neck, thick and completely united, terminating in the organ of adhesion, which has the form of a cup with a long pedicle. This species is much like *Anchorella falax*, Heller, in form except for the great size of the abdomen.

EXPLANATION OF THE PLATES.

PLATE III.

- Fig. 1. Caligus brevipedis*, sp. n., ♀. × 6.
 a 1. Frontal plate with anterior antenna. a 2. Posterior antenna. Ha. Hamulus subsidiarius anterior. Md. Mandible with palp. F. Furcula. 1 P, 2 P, 3 P. Peræopods. 4 P & 4. Peræopod slightly and highly magnified. 5 P. Rudimentary fifth peræopod. C.P. Caudal plate.
- Fig. 2. Caligus scomberi*, sp. n., ♀. × 6.
 A 2. Posterior antenna. F. Furcula. 4 P. Fourth peræopod. C. Caudal plate.

PLATE IV.

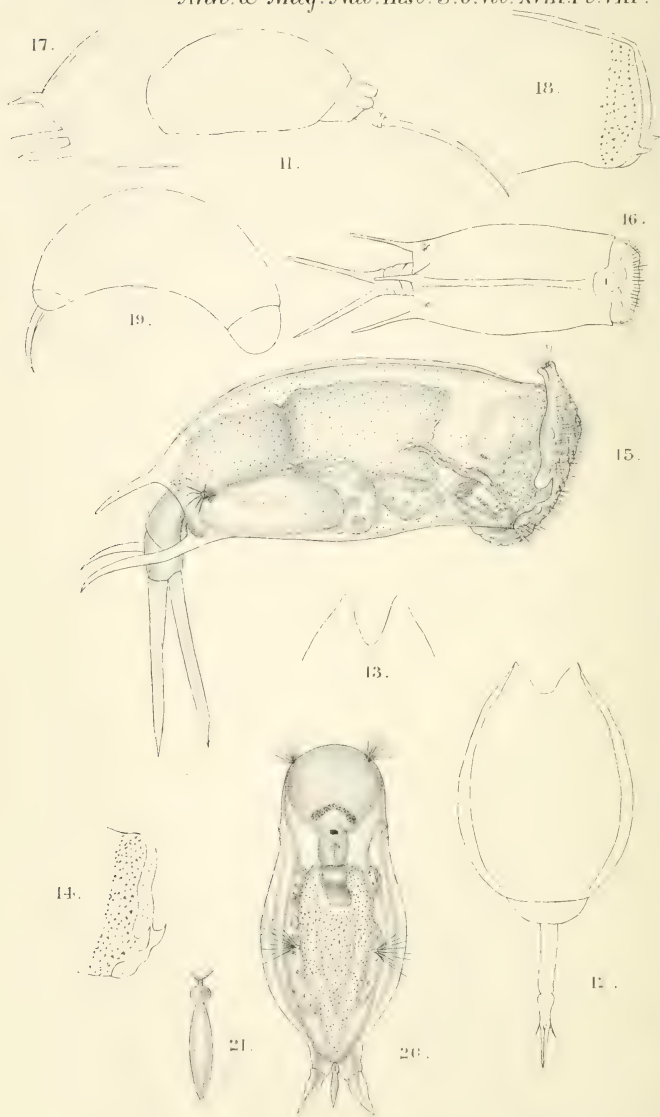
- Fig. 1. Lepeophtheirus pollachius*, sp. n., ♀. × 6.
 2 a. Posterior antenna. H.s.a. Hamulus subsidiarius anterior. F. Furcula. 4 P. Fourth peræopod.
- Fig. 2. Caligus obscurus*, Baird, ♀. × 6.
 A 2. Posterior antenna. H.s.a. Hamulus subsidiarius anterior. F. Furcula. 4 P. Fourth peræopod (see Journ. Marine Biol. Assoc. vol. iv. no. 2).
- Fig. 3. Elytrophora brachyptera*, Gerstaecker, ♀ ♂ *in situ*.
 3 a, 3 b. Spermatophores detached.
- Fig. 4. Mouth of Chondracanthus trigle*, ♀, × 20, showing maxillæ, first and second maxillipeds.
- Fig. 5. Anchorella quadrata*, sp. n. Enlarged.
- Fig. 6. Lerneæ luscæ*, nat. size, with various forms of head-processes.

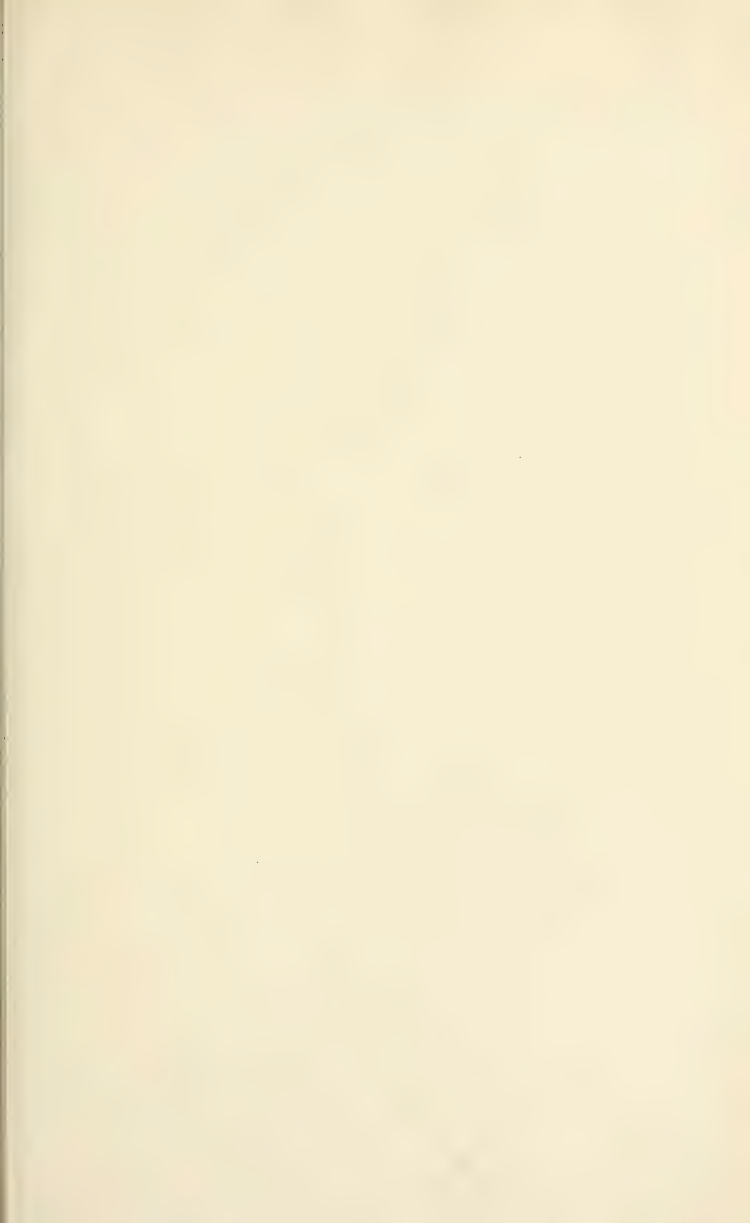
PLATE V.

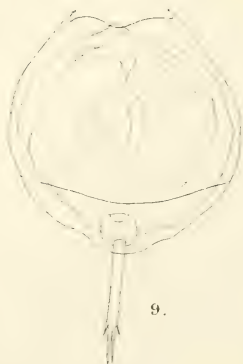
- Fig. 1. Chondracanthus clavatus*, sp. n., ♀. Nat. size.
 1 a. Anterior portion of head, with antennæ. 1 b Male.
 1 c. Mouth-organs of male.
- Fig. 2. Anchorella paradoxa*, Van Bened., ♀. Nat. size.
 2 a. Male, highly magnified. 2 b. Mouth, with first and second antennæ. 2 c. Maxilla and second maxilliped.

PLATE VI.

- Fig. 1. Brachiella merluccii*, sp. n., ♀. Nat. size.
 1 a. Organ of adhesion. 1 b. Male, enlarged. 1 c. Mouth-organs of male. 1 d. Head of female, much enlarged.
 1 e. Maxilla of female.
- Fig. 2. Brachiella insidiosa*, Heller, ♂. Much enlarged.
- Fig. 3. Brachiella trigle*, Claus, ♂. Much enlarged.







III.—Some new Forms of American Rotifera.

By Dr. ALFRED C. STOKES.

[Plates VII. & VIII.]

THE following presumably undescribed Rotifera were all taken from a shallow clear-water pool in a rocky wood near Trenton, New Jersey, U.S.A.

Mastigocerca mucosa, sp. n. (Pl. VII. fig. 1.)

Lorica in dorsal aspect elongate-elliptical in outline; in side-view obovate, about twice as long as broad (high), ventral surface evenly and slightly convex; dorsum arched, higher anteriorly, and there bearing two anteriorly diverging carinæ more than half as long as the lorica, the walls outwardly inclined, thickest at base, the furrow obliquely curved toward the front, the bottom rounded; anterior margin of lorica truncate, smooth, the posterior aperture ventrally oblique; toe as long as the lorica, slightly decurved; accessory stylets four (or five?), the longest conspicuous, curved, about one fourth as long as the slender, tapering, acute toe, the three (or four?) additional stylets setiform and about one half as long as the principal one; antennæ clavate, apparently not setigerous; lateral antennæ near the posterior extremity, in close proximity to the ventral border, finely and radiately setigerous; brain elongate-saccate, with a large papilliform purplish or black eye on its posterior extremity; alimentary canal large, broad, situated laterad and partly ventrad to the ovary, which, in the writer's specimens, was large, irregular in form, and with numerous developing germs; oesophagus long, conspicuous; contractile vesicle pulsating about twenty-four times per minute; flame-cells ("vibratile tags") large.

Length of lorica $\frac{1}{130}$ inch; foot and toe $\frac{1}{130}$; greatest height of carina $\frac{1}{1500}$.

Hab. As mentioned at the head of this paper.

The secretion of the foot-glands is often so copious that it seems to exude from the entire length and substance of the toe, whence it spreads over the glass slide in waves and filaments and fringes, and attaches the animal almost immovably, although it has the ability to withdraw the part for a short distance from its colloid sheath, when the secretion again exudes and again covers the toe as before.

I have not been able to observe even a single seta on the

dorsal antenna. If present they must be exceedingly delicate and minute.

The bottom of the dorsal furrow is elastic, as the animal can draw the lateral wings toward each other.

Taphrocampa clavigera, sp. n. (Pl. VII. fig. 2.)

Exceedingly soft, flexible, and versatile; normally subcylindrical or subfusiform, usually widest near the middle, tapering posteriorly, often producing a postero-central constriction with margins almost straight; dorsum arched, ventrum hollowed; not conspicuously annulose, but the body-margins irregularly crenate or undulate, these projections not rarely becoming obsolete; front rounded and bearing a hook-like projection, visible in side-view much as with *Taphrocampa Saundersiae*, Gosse; anterior region frequently retracted; tail represented by a small semicircular lobe dorsal to the soft and flexible subcylindrical foot; toes two, short, stout, conical, and possessing independent movement, being therefore true toes; a small rounded auricle frequently protruded on each side of the head, and so accelerating the animal's movements that it is difficult to observe the form and structure; dorsal cuticular surface conspicuously striate longitudinally or finely fluted, the striæ coarse and more or less parallel with the marginal crenulations; dorsal antenna single, represented by a circumvallation near the frontal border, and probably setigerous, although I have not actually seen the setæ; frontal cilia prone, fine, short, filling an obovate field which occupies from one fourth to one fifth of the anterior ventral surface, and surrounded by numerous subparallel striæ or fine cuticular folds; brain conspicuous, elongate-saccate, from one fourth to one fifth as long as the entire body, and having a small, posterior, central subspherical lobe, which is often coarsely granular, these freely movable granules extending toward the front of the ganglion in a long, narrow, sinuous band, the whole collection then being irregularly subclavate; in some specimens this granular formation is entirely absent or the posterior lobe may alone be granular; eye red, situated on the fore part of the posterior cerebral lobe, which is not rarely apparently adherent to the mastax, the movements of which it then accompanies; intestinal canal continuous, apparently ciliated, widest anteriorly, in lateral aspect suddenly narrowed, and tapering posteriorly, often annulose; œsophagus not observed; a coarsely granular body, presumably the ovary, ventrad to the alimentary canal and extending for almost its

entire length; a small gastric gland is present on each rostral shoulder of the stomach; contractile vesicle in the median line, ventrad to the intestine, oval in contour and conspicuous near the posterior body-margin; lateral canals present, with but four flame-cells visible on each side; two small elongate-ovate foot-glands present; animal's movements constantly writhing and vermicular when unaided by the auricles, but with these appendages rapid, headlong, and seemingly without choice of direction.

Length about $\frac{1}{120}$ inch.

Intestinal canal usually gorged with yellowish-brown food materials.

The species is readily recognizable not only by its form and by the lateral crenulations, but especially by the peculiar granular region of the brain, that particular part being in form not unjustly comparable to a pendulum with a sub-spherical bob, or to a cord with a round weight attached at one end. These granules, which I have not seen in any other portion of the ganglion, are freely movable on one another and in form vary from elongate-ovate to subfusiform. They are probably concretions of lime as so commonly observed in the cerebral ganglia of other Notomatidæ. They are here contained in a tubular case or sheath, and may be motionless by reason of their number. Even when these granules are absent the region which they will at some time occupy is always plainly visible. They seem to be the result of a crystallization within a liquid enclosed by a special membrane within the nerve-mass. The clavate form of the mass suggested the specific name.

Metopidia collaris, sp. n. (Pl. VII. figs. 3 and 4.)

Lorica suboval, depressed, the dorsum rounded, the central region a slightly flattened more or less obovate space, whose margins converge posteriorly into a central ridge extending to the posterior border of the lorica, the lateral regions of the lorica falling away rather rapidly to the convex edge, thus giving the entire dorsum a somewhat tectiform aspect, frequently increased by the presence of a central longitudinal ridge; ventrum flattened; dorsal frontal margin concave, the ventral deeply excavate; the frontal angle on each side prolonged as a conspicuous acuminate process; a narrow, coarsely stippled, collar-like band encircling the entire anterior margin of the lorica; posterior dorsal border narrow, slightly and evenly concave, the ventral margin conspicuously excavate into a deep narrow sulcus, its lateral borders but

slightly divergent, its posterior termination on each side minutely acuminate; dorsal antenna a large deep pit surrounded by a circular or broadly oval ring; lateral antennæ apparently present as small capitate dorso-lateral projections, but upon which I could discover no setæ; foot three-jointed (or four-jointed if the prolongation of the body to which the foot is a continuation be counted as a joint); toes long, tapering; eyes two, red, pectoral, crescentic, placed near the frontal border, in some specimens the appearance of an additional pair of faintly coloured crescentic eye-spots not being rare on the pectoral region; flame-cells small, only one (near the postero-lateral border) having been observed; lateral canals exceedingly numerous, especially in the dorsal region, where they extend beneath the lorica in long loops and in concentric curves, each canal terminating in a trumpet-shaped mouth apparently not ciliated, and without an undulating membrane, the vessels together imperfectly separable into three groups, one central, two lateral; contractile vesicle large, ventrally and transversely placed near the anterior extremity of the ventral sulcus and variously compressed and changed in form by the pressure of the viscera.

Length about $\frac{1}{30}$ inch; length of lorica $\frac{1}{14}$; toes and foot $\frac{1}{33}$.

The figure (made with a camera lucida) was drawn from a specimen under slight pressure, and the head is therefore too much rounded and too prominent.

The frontal plate is movable and flexible. When the body is contracted this plate is folded over the rounded part and serves as a protection to the otherwise defenceless region.

This seems to be the only known species with a stippled band around the front border. This feature, together with the lateral spinous processes, and especially with the numerous canals of the vascular system, with their curves and their trumpet-shaped mouths, makes the form one easily recognizable. The Rotiferon frequently, I think usually, swims on the back, thus concealing some important and interesting structural features.

Metopidia collaris, var. *similis*, nov.

(Pl. VII. fig. 5.)

The foregoing species is so frequently accompanied or even replaced by one or more varieties so distinct from it in the form and the size of the lorica, that it merits varietal recognition and a varietal name, as I have given it.

The lorica is evenly oval in outline, depressed, the ventrum

slightly concave, the dorsum arched, conspicuously or not, tectiform when the central, longitudinal, ridge-like elevation is present, as it may or may not be; two low, lateral, posteriorly converging ridges conspicuously or obscurely developed or entirely absent, but when present the enclosed more or less obovate dorsal space surrounded by them is flattened; frontal dorsal margin evenly but deeply concave; ventral border excised much as in *Metopidia collaris*; frontal angles acuminate, not produced into spinous processes; dorsal posterior border very slightly concave; posterior ventral margin deeply excised, the lateral borders of the excision diverging or parallel; collar-like frontal band usually present, sometimes coarsely and abundantly punctate, sometimes entirely smooth; foot and toes essentially as in *Metopidia collaris*; internal organization not apparently differing from that of the type.

Length about $\frac{1}{100}$ inch; length of lorica alone $\frac{1}{300}$; toes $\frac{1}{1000}$; foot and toes $\frac{1}{400}$.

This differs from the type in the deeper concavity of the front of the dorsum, in the reduction of the lateral spines to mere acuminations, in the absence of the slight posterior acumination terminating the posterior ventral excision, and in the smaller size, although the size alone is of little importance.

Internally there appear to be no prominent differences, except that I have not positively observed the peculiar arrangement of the lateral canals within the dorsum which seems so characteristic of *M. collaris*; but these often are obscure in that species when the ovarian germs are well advanced or when the egg is well developed, or sometimes even when the alimentary canal is gorged with food or with its remains.

Monostyla hamata, sp. n.
(Pl. VII. figs. 6, 7, and 8.)

Lorica broadly ovate in outline; front differing in form on both the dorsal and the ventral surfaces, as shown by figs. 6 and 7 better than any verbal description could do. The figures were drawn with the camera lucida, and represent the lorica frontally dilated as it is when the enclosed body is retracted; when the animal is extended the elastic front is narrower than here shown, and the two acuminations on each side of the dorsal excavation become less conspicuous; foot and toe together about one half as long as the lorica; toe not shouldered.

When the body is extended it bears on its front dorsal margin three sub-semicircular membranous lobes (fig. 8), the

lateral two extending to the ventral surface, their outer borders apparently thickened into a small chitinous hook, the inner surfaces of these membranes coming into contact when the body is retracted, then frequently forming a nipple-like projection; brain large; œsophagus lined by long, conspicuous, flagella-like cilia, which are pendent into the stomach.

Length, including toe, $\frac{1}{190}$ inch.

Monostyla robusta, sp. n. (Pl. VII. figs. 9 and 10.)

Lorica subcircular in outline, but little longer than broad; ventral surface flattened, dorsal arched, steeply sloping anteriorly when the animal is contracted, the frontal region of the lorica being flexible; frontal borders concave, undulate, the ventral with a broad central emargination; each lateral frontal angle terminated by a short incurved acumination; toe rod-like, straight, terminating in two short acuminate claws, distinctly parted, especially at their extremities, and projecting from between two small setiform spines; entire lorica coarsely punctate, lateral antennæ small, projecting on each side within the lateral sulcus, near the posterior extremity and from the upper surface of the lower or ventral region of the groove; dorsal antenna a single setigerous circumvallation; brain conspicuous, large; eye single, large, circular, red, granular, and superficially placed near the middle of the nerve-ganglion; the stomach bears internally, near the entrance of the œsophagus, a ligulate undulating membrane (or tube?), coarsely striate longitudinally, and about $\frac{1}{1000}$ inch long.

Length of lorica, including toes and claws, $\frac{1}{136}$ inch; length of lorica alone $\frac{1}{150}$ inch; width $\frac{1}{219}$. Toes and claws together about one half as long as the lorica.

The claws are distinctly, even conspicuously, two, being visibly parted throughout their entire length, and actually separated at their tips; they are immovable, or appear to be so.

The general form, the frontal acuminations, the parted claws between the setiform spines make the species one that is easily recognizable, and not likely to be mistaken for any other thus far observed.

No varieties of the species have yet been found, although one or more may probably exist. I have, however, observed a specimen with the toe and claws as shown in fig. 10, where there was but one setiform spine, stouter and more conspicuous than usual, and where the toe was undulate and peculiarly malformed.

Monostyla bipes, sp. n.
(Pl. VIII. figs. 11, 12, and 13.)

Lorica broadly oval, the dorsal surface strongly gibbous, the ventral only slightly rounded, nearly plane (fig. 11); a posterior retrocession obliquely and convexly truncate, and overhanging a broad somewhat oblique extension; frontal border deeply emarginate, the ventral emargination nearly twice as deep as the dorsal, both incisions posteriorly rounded (figs. 12 and 13); entire surface of lorica stippled; toe about three fourths as long as the entire lorica, somewhat decurved and tapering in lateral view; in ventral aspect minutely emarginate near the middle, beyond which it is slightly constricted, and has on each side a fine setiform spine, from between which extends the tapering claw, which is in reality double, having at or near the level of the setiform spines a small brightly refractive spot, which represents an aperture and from which passes posteriorly a distinct dark line dividing the claw into two, these portions never being widely parted, but readily resolvable into two.

The internal anatomy, with the exception of the œsophagus, presents nothing of unusual structure. The œsophagus, however, encloses a structure readily observable when in action, but difficult to interpret. The optical appearance is that of an endless series of internal rings gliding along the œsophagus toward the stomach. There is no visible return of the travelling circles, but the procession is endless and continuous. That the appearance is produced by the undulations of a spiral membrane, as in the flame-cells of so many of the Rotifera, is hardly probable; that, in addition to the ordinary lining of minute cilia, the œsophagus bears a series of large flagelliform cilia arranged spirally on the inner wall, or that true flagella may thus be arranged there, are suggestions more easily made than proved. But the fact remains that the downwardly gliding ring-like bodies, whatever their true character may be, are conspicuous features within the œsophagus of the species, and are probably flagella or a single long flagellum spirally encircling the tube.

Length, including foot, $\frac{1}{15}$ inch.

At the death of the animal I have distinctly seen the two claws slightly parted, so that there was a clear space between them, and the terminal point, usually single in appearance, became plainly double. It is to emphasize this part of the anatomy that I have given this species a name which, with the generic title, makes a rather unusual collocation.

Salpina similis, sp. n.
(Pl. VIII. figs. 14, 15, 16, 17, and 18.)

Lorica much as in *Salpina brevispina*, Ehr. Occipital spines entirely wanting; the pectoral pair short, acute, wide at base and strongly curved upward (fig. 14); posterior spines long and conspicuous, the alvine pair nearly twice as long as the lumbar one, with a slight upward curve, the lumbar being at the termination of the dorsal cleft and slightly recurved; entire surface finely stippled, a broad coarsely punctate band or collar surrounding the frontal region (fig. 14); dorsal cleft (fig. 16) narrow, elastic, with a deep depression at its frontal termination, its lateral borders sloping outward from a straight base; lateral antennæ present near the posterior border (figs. 15 and 16), the nerve-fibre prominent, at first filiform, whence it conspicuously widens to become again thread-like; frontal antenna lobe-like; brain large, its latero-ventral region appearing to bear several fusiform lobes; mastax globose; œsophagus long, variously curved, and lined by long, conspicuous, flagella-like cilia, which are pendent within the stomach and plainly distinct from its lining of short fine cilia; a gastric gland attached on each side to the antero-inferior region of the stomach; ovary ventrad, extending transversely to the stomach and the intestine; contractile vesicle nearly one half as long as the lorica, and, when fully dilated, crowding the ovary forward against the gastric glands; two small, broadly ovate, ventral glands, one on each side near the posterior extremity, apparently foot-glands.

Length, including toes, $\frac{7}{8}$ inch.

The points of difference between this species and the *Salpina brevispina* of Ehrenberg are the long posterior spines, the acute, curved pectoral spines, the deep, broad, more or less rectangular, dorso-frontal emargination, and the long œsophageal flagella, which are so obtrusive that they could not be overlooked if they were present in *S. brevispina*. *S. similis* is twice as large as *S. brevispina*.

In a single instance, and entirely by accident, while subjecting the Rotiferon to pressure, living spermatozoa were forced from the cloacal orifice into the surrounding water, where they soon died. When viewed with insufficient magnifying power each spermatozoon seemed to be a minute sphere with a single long flagellum; but this is by no means certain. The seminal receptacle was not seen.

A somewhat smaller variety of this species occurs in the same pool. It differs from the foregoing in having the pectoral spines straight (fig. 18), the alvine and the lumbar

nearly straight, the alvine being somewhat the shorter (fig. 17), and all shorter than those of *S. similis*. The sinus between the posterior spines (fig. 17) shows a rather conspicuous bulging, while in *Salpina similis* the sulcus is entirely even and evenly rounded. The front is likewise more evenly rounded (fig. 18), with a more decided bulging at or near the buccal orifice. Internally the only apparent differences are the smaller contractile vesicle of the variety and the strong internal ciliation of the œsophagus, instead of the conspicuous flagella as with *S. similis*, the œsophageal cilia of the variety scarcely differing from those of the stomach, and not extending into that organ as an undulating fascicle. The granulations of the anterior lorical collar are coarser and fewer than those of the same part on *Salpina similis*. These points of difference are hardly sufficient to warrant the describing of these specimens as a new species.

Rattulus palpitatus, sp. n. (Pl. VIII. fig. 19.)

Lorica subcylindrical, widest anteriorly, somewhat tapering posteriorly, both extremities truncate, but in opposite directions; toes curved, continuing the general curvature of the lorica, tapering, acute, about one fourth as long as the body; basal stylet apparently none; dorsal contour of the lorica in lateral view closely approximating the segment of a circle; brain not opaque, large, broadly ovate, bearing at its posterior extremity a large red papilliform eye-spot; mastax large, the trophi unequal; gastric glands dorsad to the frontal region of the stomach and apparently united into one; ovary large, ventrad to the ciliated stomach and to the intestine; contractile vesicle small, near the posterior extremity of the lorica, in the median line, and pulsating at the rate of about forty contractions per minute, the cloaca being forced open for a short distance at each pulsation.

Length of the extended body, exclusive of the toes, about $\frac{1}{2\frac{1}{10}}$ inch; greatest lateral width (height) near the middle of the lorica and about $\frac{1}{8\frac{1}{10}}$ inch.

The species is remarkable on account of the rapidity with which the contractile vesicle pulsates, the number averaging about forty each minute when the animal's movements are but slightly restricted and when it seems to be well and at ease; when it is held by the pressure of the cover-glass the pulsations become irregular.

The toes I have not seen separated.

It is not easy to retain the curved and rigid body so that either a direct dorsal or ventral view may be obtained, but

from the few glimpses which I have had of the dorsal aspect the gastric gland seems to be single, narrow, and to extend obliquely across the frontal region of the stomach; but of this there is no certainty, as momentary glances were all that I could obtain, the body always slipping over to its side. The animal's unrestrained movements are rotatory on its longitudinal axis.

Notommata mirabilis, sp. n. (Pl. VIII. figs. 20 and 21.)

Body very soft and versatile; in dorsal view broadly ovate, posteriorly prolonged into a foot-like portion; dorsum rounded; ventrum flattened; front evenly and broadly convex, and entirely without cilia, which are confined to an anterior obovate space on the ventral surface; auricles small, sub-hemispherical, rarely protruded; lateral borders of the body projecting on each side beyond the elevated and rounded dorsal region as a flattened cuticular extension; posterior region narrowed and prolonged ventrally into two broad conical toes, and dorsally into a narrow irregularly cylindrical tail, which is shorter and smaller than the toes and habitually held almost perpendicularly, so that when the animal is seen in dorsal aspect this appendage appears in optical section like a small ring or an elongated papilla, but in lateral view is seen to be attached to the body by a minute peduncle, above which it is subglobose inflated, tapering thence with convex borders to the subacute apex; sense-organs (antennæ or tentacles) four in number—one a small densely setigerous pimple on each side of the convex front, and one a rather more conspicuous seta-bearing papilla on each lateral border of the dorsum, somewhat posterior to the transverse median line; brain large, not lobed, translucent, with one or more posterior collections of opaque granules and with a dark, almost black, posterior eye-spot; contractile vesicle posterior, in the median line, large, and, when fully expanded, about one third as long as the body.

Length from $\frac{1}{150}$ to $\frac{1}{167}$ inch.

The somewhat tripod combination of foot and tail bears considerable resemblance to those parts in *Notommata tripus*, Ehr., and in *Notommata pilarius*, Gosse; but the species is readily separated from both not only by the less robust character of the tail, by its form and its perpendicular position, but by the exceedingly peculiar and characteristic, not to say unique, sense-organs, which at once distinguish it from all known forms of the genus, and place it within not distant

relationship to *Copeus*, from which it is separated by the smaller size, the more active movements, and especially by the entire non-lobate brain.

The stomach bears an internal undulating organ similar in general appearance and in movement to the membranous appendage within the stomach of *Monostyla robusta* and of certain other Rotifera. The animal has entire control over the movements of this appendage, hastening or retarding them, or throwing the membrane into various convolutions and irregular vibrations.

The wing-like extensions of the body apparently carry none of the internal anatomy except the lateral canals, which are almost entirely contained within a narrow elongate mass of granular tissue, where there seems to be but one flame-cell, and that usually indistinct. Other vibratile cells probably exist, but they are not ordinarily visible. With many specimens of the Rotiferon, which is not rare in my locality in New Jersey, I have not been able to discover any other arrangement than this of the vascular system.

The tail is usually as shown in the figure (fig. 21), but occasionally the bulbous portion is less distinct, while the entire appendage seems to be somewhat elastic and changeable.

EXPLANATION OF THE PLATES.

PLATE VII.

- Fig. 1. *Mastigocerca mucosa*.
- Fig. 2. *Taphrocampa clavigera*.
- Fig. 3. *Metopidia collaris*. Ventral view.
- Fig. 4. Ditto. Front of dorsum.
- Fig. 5. *Metopidia collaris*, var. *similis*. Lorica.
- Fig. 6. *Monostyla hamata*. Dorsal view.
- Fig. 7. Ditto. Ventral view.
- Fig. 8. Ditto. Expanded front.
- Fig. 9. *Monostyla robusta*.
- Fig. 10. Ditto. Malformed toe.

PLATE VIII.

- Fig. 11. *Monostyla bipes*. Lateral view.
- Fig. 12. Ditto. Dorsal view.
- Fig. 13. Ditto. Ventral front.
- Fig. 14. *Salpina similis*. Front of lorica.
- Fig. 15. Ditto. Side view of animal.
- Fig. 16. Ditto. Dorsal view of animal.
- Fig. 17. Ditto. Posterior extremity of small variety.
- Fig. 18. Ditto. Lorica front of small variety.
- Fig. 19. *Rattulus palpitatus*. Lateral view.
- Fig. 20. *Notommata mirabilis*.
- Fig. 21. Ditto. Tail.

IV.—*Descriptions of some new Genera and Species of Heterocera from Central and Tropical South America.* By HERBERT DRUCE, F.L.S. &c.

THE new species from Central America will be figured in the 'Biologia Centrali-Americana.'

Fam. Castniidæ.

Castnia Staudingeri, sp. n.

Primaries reddish brown, shading to yellowish brown in the middle; a large brown spot at the end of the cell and three smaller brown spots near the anal angle; two round hyaline white dots near the apex; the fringe yellowish brown: secondaries deep orange, shading to pale yellow in the middle and on the inner margin, the base black, thickly clothed with dark brown hairs; a wide band of deep black submarginal spots extends from the anal angle almost to the apex, the spots become smaller near the apex; the outer margin edged with blackish brown, becoming wider near the anal angle; the fringe yellow. Underside of primaries orange, of secondaries pale whitish yellow, with the markings as above, but quite indistinct. Head, antennæ, and thorax reddish brown; abdomen blackish brown at the base, then to the anus thickly irrorated with yellow scales, the anus orange; the underside of the thorax and abdomen yellowish white, the legs dark reddish brown above, whitish on the underside.

Expanse 4 inches.

Hab. Panama, Chiriqui (*Trötsch*, in *Mus. Staudinger*).

I have great pleasure in naming this fine species after Dr. Staudinger, who has kindly lent it to me with many others for the 'Biologia,' where I hope it will shortly be figured.

Fam. Agaristidæ.

Phasis præfectus, sp. n.

Primaries dark blackish brown: secondaries bright citron-yellow, broadly bordered with black. The head, antennæ, palpi, thorax, and legs black; abdomen yellow, with a central black band and one on each side, all extending from the base to the anus; the anal tuft black.

Expanse 2 inches.

Hab. Bolivia (*Mus. Druce*).

Fam. Zygænidæ.

Histiæa maon, sp. n.

Primaries and secondaries dark brown; primaries streaked with red from the base almost to the middle; a metallic blue spot at the base and a metallic blue streak at the end of the cell, beyond which the wing is partly crossed by a rather wide yellow band, which does not reach either margin; the fringe dark brown: secondaries with a round carmine spot below the cell nearest the outer margin, the fringe brown. The head, thorax, antennæ, and legs dark brown; a metallic blue dot on each side of the head and one on the base of each of the tegulæ; the upperside of the abdomen very bright metallic blue, the underside dark brown.

Expanse $2\frac{3}{4}$ inches.

Hab. Bolivia (*Mus. Druce*).

Pseudosphonoptera demoanassa, sp. n.

♂. Primaries and secondaries dull black; a small hyaline streak on the costal margin close to the base, below which is a rather wide short metallic green streak; the fringe of both wings black. Underside very similar to the upperside; the secondaries have a short green streak on the costal margin. The head, antennæ, thorax, and abdomen black; collar spotted with green; abdomen striped with green from the base to the anus; legs black.

Expanse $1\frac{1}{2}$ inch.

Hab. Panama, Chiriqui (*in Mus. Staudinger*).

Macrocneme cyllarus, sp. n.

Primaries and secondaries deep black, the primaries shot with green about the middle, extending from the costal margin across the wing, but not reaching the inner margin; the fringes of both wings black. The head, palpi, and thorax black; the abdomen bright metallic green on the underside, with two white lines which extend from the base to the anus; antennæ black, the tips white; legs black, spotted with white.

Expanse $1\frac{1}{4}$ inch.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*); Toboga Isl. (*J. J. Walker*).

Homæocera sahacon, sp. n.

Primaries and secondaries yellowish hyaline; primaries with the costal and inner margins near the base pale yellow;

a bright blue spot at the base of the wing; the veins, apex, outer and inner margin black: secondaries with a black spot at the anal angle. The head, antennæ, thorax, and legs black; abdomen deep blue-black, the segments edged with yellow.

Expanse $1\frac{8}{10}$ inch.

Hab. Panama, Volcan de Chiriqui (*Trötsch, in Mus. Staudinger*).

This fine species is allied to *Homœocera dalsa*, Schaus, from Brazil.

Homœocera samina, sp. n.

Female.—Primaries and secondaries hyaline, the veins, apex, outer and inner margins of both wings black; antennæ and thorax black; the head, tegulæ, and abdomen bright orange, the abdomen with each segment edged with black, and a central row of metallic blue spots extends from the base to the anus; legs orange-yellow.

Expanse $1\frac{1}{2}$ inch.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*).

Very distinct from any described species.

Læmocharis nox, sp. n.

Primaries and secondaries smoky hyaline, with the veins all black. Antennæ, head, thorax, abdomen, and legs black; tegulæ and a spot at the base of the abdomen bright carmine.

Expanse $1\frac{1}{4}$ inch.

Hab. Honduras (*Wittkugle, in Mus. Staudinger*).

Læmocharis fenestrata, sp. n.

Male.—Primaries brownish black, palest at the base and along the inner margin; the end of the cell and a band of four small spots beyond hyaline white: secondaries hyaline, the costal margin, apex, and outer margin broadly bordered with black; the fringes of both wings black. The head, antennæ, thorax, tegulæ, abdomen, and legs black; abdomen with a chrome-yellow spot on each side above the anus.—*Female* almost identical with the male.

Expanse, ♂ ♀, 1 inch.

Hab. South Brazil (*Mus. Druce*).

Cosmosoma meres, sp. n.

Primaries yellowish hyaline, the costal margin and the base deep yellow; the apex, outer and inner margins black;

the veins black : secondaries hyaline, the costal margin yellow, outer and inner margins black. The head, antennæ, thorax, and abdomen black, the abdomen spotted with blue ; two spots at the base of the abdomen and two about the middle dark chrome-yellow ; legs black.

Expanse $1\frac{1}{4}$ inch.

Hab. Panama, Chiriqui (Trötsch, in Mus. Staudinger).

Ilipa unxa, sp. n.

Primaries yellowish hyaline, the costal margin from the end of the cell to the apex black ; the apex broadly black, the base of the wing and the veins black : secondaries hyaline, edged with black at the apex and anal angle. Head metallic green ; antennæ, tegulæ, thorax, abdomen, and legs black ; the anal segment of the abdomen metallic green ; a small red spot on each side of the abdomen at the base.

Expanse $1\frac{3}{10}$ inch.

Hab. Panama, Volcan de Chiriqui (Trötsch, in Mus. Staudinger).

Dycladia ladan, sp. n.

Primaries and secondaries clear hyaline, the veins, costal, outer, and inner margins, and a rather wide band crossing the wing from the costal margin to the anal angle all black. Antennæ, head, thorax, abdomen, and legs black, the abdomen spotted with red at the base.

Expanse $1\frac{1}{10}$ inch.

Hab. Panama, Chiriqui (Trötsch, in Mus. Staudinger).

PHÆNARETE, gen. nov.

Type *P. diana*, Druce.

Antennæ minutely ciliated, rather short. Palpi upturned, the third joint very short ; legs slender, without any tufts. Head small, thorax stout, abdomen short and thick. Wings very long and narrow, costal margin straight ; secondaries wider than the primaries.

Phænarete diana, sp. n.

Primaries hyaline ; the base, veins, a narrow band crossing the wing at the end of the cell, and the apex and inner margin all black : secondaries hyaline, the veins and outer margin black ; a small white dot on the costal margin of the primaries close to the base. The head, antennæ, thorax, abdomen, and legs black ; a small white spot on each side of

the head and a row of white spots on each side of the abdomen; the abdomen white at the base on the underside.

Expanse $1\frac{1}{2}$ inch.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*).

Argyroeides moza, sp. n.

Primaries and secondaries yellowish hyaline, the veins all dark brownish black; primaries with the costal margin from the base to the apex bright carmine, the outer and inner margins bordered with black, widest near the apex: secondaries edged with black from the apex to the anal angle. The antennæ, head, thorax, and abdomen black; abdomen white at the base and antennæ white at the tip; legs black; anus carmine.

Expanse $1\frac{1}{4}$ inch.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*).

Argyroeides (?) *faveria*, sp. n.

Female.—Primaries and secondaries hyaline; primaries, the base, costal and inner margins, and veins chrome-yellow to the middle of the wing, beyond which the veins are black; the apex broadly black, the outer margin edged with black, and an elongated black spot at the anal angle: secondaries with the apex edged with black. The head, antennæ, and palpi deep black; the collar, tegulæ, thorax, and basal half of the abdomen deep chrome-yellow; the anal segments of the abdomen black.

Expanse $1\frac{1}{10}$ inch.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*).

Argyroeides strigula, sp. n.

Male.—Primaries and secondaries yellowish hyaline, the veins black; the outer margin of the primaries and the apex and inner margin of the secondaries black. The head, antennæ, and thorax black; tegulæ red; abdomen black, yellow at the base, and each segment edged with red.

Expanse 1 inch.

Hab. South Brazil (*Mus. Druce*).

Argyroeides gyas, sp. n.

Male.—Primaries and secondaries yellowish hyaline, the costal and outer margins narrowly edged with black; second-

aries with the inner margin black. The head, antennæ, thorax, tegulæ, abdomen, and legs all dull smoky black.

Expanse $1\frac{1}{10}$ inch.

Hab. South Brazil (*Mus. Druce*).

Trichura augiades, sp. n.

Male.—Primaries and secondaries hyaline, the veins black; the outer and inner margins of both wings edged with black. The head, collar, tegulæ, and thorax bright carmine; the abdomen greenish black, slightly metallic on the three anal segments; palpi black, white in front. The underside of the thorax, abdomen, legs, and antennæ black.

Expanse $1\frac{3}{10}$ inch.

Hab. Bolivia (*Mus. Druce*).

NEOTRICHURA, gen. nov.

Type *N. penates*, Druce.

Allied to *Trichura*, but differs in having two brands on the upperside of the inner margin of the primaries and the costal margin of the secondaries being turned over on the underside, forming a kind of sack, containing a tuft of silky white hair. The wings are also more pointed than they are in *Trichura*; in other respects it is very similar to that genus.

Neotrichura penates, sp. n.

Primaries and secondaries clear hyaline, with the veins all black; primaries, the apex, outer and inner margins broadly bordered with black; on the inner margin about the middle are two pale brown brands: secondaries, the apex, costal and inner margins broadly bordered with black. The head, thorax, abdomen, and legs black; antennæ black, tipped with white; the front of the thorax, a spot on each side of the head, the base and sides of the abdomen metallic blue.

Expanse $1\frac{3}{4}$ inch.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*).

Syntrichura reba, sp. n.

Primaries and secondaries hyaline, the veins, costal, outer, and inner margins of both wings all black. The head, base of the thorax, and last two segments of the abdomen bright metallic blue; the thorax, tegulæ, and abdomen black, the abdomen banded with white at the base; collar greyish white; antennæ and legs black.

Expanse 1 inch.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*).

Syntrichura philocles, sp. n.

Primaries and secondaries hyaline, the veins, apex, outer and inner margins of the primaries black: secondaries, the costal margin white, the apex and outer margin edged with black. The head, antennæ, thorax, and abdomen black; a carmine spot on each side of the head; underside of the abdomen banded with white, and a row of white spots on each side; the legs black.

Expanse $1\frac{1}{10}$ inch.

Hab. Panama, Chiriqui (*Trötsch*, in *Mus. Staudinger*).

ENIOCHE, gen. nov.

Type *E. pitthea*, Druce.

Male.—Antennæ very long, slightly pectinated. Palpi small, standing out from the head, the third joint very short. Thorax and abdomen rather stout; legs long, slender, and without spurs. Primaries broad, the costal margin straight, the outer margin very much rounded, the inner margin very short. Secondaries almost wanting.

Enioche pitthea, sp. n.

Male.—Primaries hyaline, the costal margin, veins, apex, and outer margin black; a small blue dot at the base of each wing: secondaries black, very minute. The head, antennæ, thorax, and legs black; abdomen metallic blue; underside of the thorax white.

Expanse $1\frac{3}{10}$ inch.

Hab. Peru (*Mus. Druce*).

Fam. Arctiidæ.

Charidea ira, sp. n.

Male.—Primaries deep black, edged at the base on the inner margin with a metallic blue streak; a wide bright carmine band extends from the base to the end of cell and then to the anal angle; the inner margin of the wing black: secondaries black, with the apex bright carmine; the fringes of both wings black. Antennæ and palpi black; head, thorax, and abdomen bright metallic blue, thorax clothed with black hairs and abdomen banded with black. Underside very similar to the upperside.

Expanse $1\frac{4}{10}$ inch.

Hab. Panama, Chiriqui (*Trötsch*, in *Mus. Staudinger*).

Charidea azetas, sp. n.

Primaries dark brown, the costal margin from the base almost to the apex and the fringe chrome-yellow; a small streak at the base and a round spot below the end of the cell bright carmine: secondaries black, shot with bright blue at the base; a large carmine spot extends from apex to the middle of the outer margin; the fringe chrome-yellow. Underside very similar to the upperside, but more metallic blue at the base of both wings, and the red spot on the primaries very much larger. The head, antennæ, tegulæ, and thorax black; the collar, edges of the tegulæ, and a line down the middle of the thorax metallic green; abdomen black, banded with metallic green; underside of the abdomen white.

Expanse $1\frac{1}{2}$ inch.

Hab. Colombia (*Mus. Druce*).

Charidea lystra, sp. n.

Primaries dark brown, the base and inner margin close to the base metallic blue; a small red spot close to the base; fringe white: secondaries blue-black, the outer margin broadly bordered with bright carmine; the fringe chrome-yellow. Underside very similar to the upperside, but with more blue on both wings. The head, thorax, and abdomen bright metallic blue; antennæ and palpi black; tegulæ black, edged with metallic blue.

Expanse $1\frac{7}{10}$ inch.

Hab. Colombia (*Mus. Druce*).

Aclytia? laudabilis, sp. n.

Male.—Primaries dark brown, the veins almost black; a small yellow spot close to the base and a minute metallic green spot on the costal margin: secondaries yellow, broadly bordered with dark brown. The head, antennæ, thorax, and abdomen black; the collar and tegulæ metallic green on the upperside, on the underside entirely metallic green.—*Female* almost identical with the male, but slightly paler in colour.

Expanse $1\frac{4}{10}$ inch.

Hab. Bolivia (*Mus. Druce*).

PSEUDOCHARIDEA, gen. nov.

Allied to *Charidea*, from which it differs in the primaries being broader, the costal margin considerably arched about

the middle, the apex more rounded, and by having two brands on the underside close to the costal margin nearest the apex. The secondaries are very similar to those of *Charidea*, but are more rounded at the apex. The antennæ are rather long and slightly pectinated. In all other respects it is very similar to *Charidea*.

Pseudocharidea eion, sp. n.

Male.—Primaries deep black, streaked with metallic blue at the base and on the costal margin; a wide orange-yellow band crosses the wing about the middle, extending from the costal margin almost to the anal angle; the fringe black: secondaries black, shot with bright metallic blue from the base; the outer margin from the apex to the anal angle broadly bordered with orange-yellow; the fringe yellow. The underside very similar to the upperside, but with rather more blue on the wings. The head black, collar streaked with blue; a white dot on both sides of the head; tegulæ black, edged with metallic blue; thorax and abdomen bright metallic blue, abdomen with a black line on each side; underside of thorax white; antennæ black; legs slightly metallic blue-black.

Expanse $1\frac{3}{4}$ inch.

Hab. Panama, Chiriqui (*Trötsch*, in *Mus. Staudinger*).

Automolis tegyra, sp. n.

Primaries deep black, crossed from the costal to the inner margin by two wide primrose-yellow bands, the first near the base, the second nearest the apex: secondaries yellow, broadly bordered with black. The underside the same as above. The head, antennæ, palpi, and thorax black; the collar, front of thorax, and tegulæ primrose-yellow; abdomen dark chrome-yellow, the two anal segments black, edged with metallic blue; the legs black.

Expanse $1\frac{1}{2}$ inch.

Hab. Panama, Chiriqui (*Trötsch*, in *Mus. Staudinger*).

Automolis salma, sp. n.

Male.—Primaries and secondaries pale primrose-yellow; secondaries slightly darker along the inner margin; a small black spot on the inner margin of the primaries close to the anal angle. The head, collar, thorax, and tegulæ primrose-yellow; abdomen chrome-yellow, with a large metallic blue

spot on the last two segments; antennæ, palpi, and legs black.

Expanse $1\frac{4}{5}$ inch.

Hab. Panama, Chiriqui (*in Mus. Staudinger*).

Pionia raca, sp. n.

Primaries pale yellowish brown, without any marking: secondaries hyaline, the costal margin yellowish, the apex and outer margin slightly edged with black. The head, thorax, and tegulæ yellowish brown; antennæ, palpi, abdomen, and legs black; underside of the thorax and three basal segments of the abdomen yellowish brown.

Expanse $1\frac{6}{10}$ inch.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*).

Belemnina Trötschi, sp. n.

Male.—Primaries deep black, bronze-green at the base, and extending outwards to about the middle of the cell, beyond which the wing is crossed from the costal almost to the outer margin above the apex by a wide deep orange-yellow band: secondaries deep black, the base shot with bright metallic blue; the fringes of both wings black. Underside similar to the upperside, but with both wings shot with bright metallic blue; the secondaries with two blue dots beyond the middle. The head, antennæ, thorax, collar, and tegulæ deep black, the collar and tegulæ spotted with metallic blue dots, the thorax with two rather large metallic blue spots at the base: the abdomen dark bronze-green, on the underside bright carmine; the segments on each side of the abdomen are edged with metallic blue; legs black.—*Female* very similar to the male, but with much more blue on the secondaries.

Expanse, ♂ $2\frac{1}{10}$, ♀ $2\frac{1}{2}$ inches.

Hab. Costa Rica. Panama, Volcan de Chiriqui (*Trötsch, in Mus. Staudinger*).

I have named this very fine *Belemnina* after Herr Trötsch, who has sent so many new species to Dr. Staudinger from Chiriqui. The male is from the Volcan de Chiriqui and the female from Costa Rica.

Belemnina lydia, sp. n.

Primaries deep black, the base and a large square-shaped spot at the end of the cell bright metallic green: secondaries deep black; the fringes of both wings black. Underside:

primaries very similar to the upperside, but with the green spots much larger and brighter; secondaries with the base and two large spots beyond the middle very bright metallic green. The head metallic green, the palpi and antennæ black; tegulæ and thorax black, spotted with metallic green; abdomen deep black, spotted with metallic green on each side from the base to about the middle, the underside bright carmine.

Expanse $1\frac{3}{4}$ inch.

Hab. Colombia (*Mus. Druce*).

Belemnia rezia, sp. n.

Primaries: the basal half of the wing yellowish bronze-green, the outer half black, crossed from the costal margin to near the anal angle by a wide red-carmine band: secondaries deep black; underside of primaries very similar to the upperside, excepting that the primaries are blue-green at the base: secondaries with the basal half of the wing and two round spots about the middle bright metallic blue-green. The head, antennæ, thorax, abdomen, and legs black; the base of the abdomen and three spots on each side metallic green; the underside yellowish red.

Expanse 2 inches.

Hab. Interior of Colombia (*Mus. Druce*).

This fine species is allied to *B. jovis*, Butler.

Eucereon demonis, sp. n.

Primaries greyish black, with indistinct darker black markings; a square spot at the end of the cell and a broken band beyond partly crossing the wing, both hyaline: secondaries hyaline, broadly bordered with glossy bluish black, the veins black. Head, antennæ, thorax, and abdomen black; abdomen on the underside with white bands; a spot on each side of the head, one at the base of the abdomen, and two on each side of the abdomen, all bright carmine; legs black.

Expanse $1\frac{3}{4}$ inch.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*).

Neritos cotes, sp. n.

Primaries greyish brown, with a large U-shaped citron-yellow mark on the costal margin, and on the outer margin a smaller citron-yellow mark; the fringe yellow: secondaries chrome-yellow. Palpi and antennæ greyish brown; head

yellow; collar, tegulæ, and thorax brown; abdomen and legs chrome-yellow.

Expanse $1\frac{4}{10}$ inch.

Hab. Costa Rica, Candelaria Mts. (*Underwood*).

This species is allied to *Neritos flavoroseus*, Walk.

Neritos tipolis, sp. n.

Primaries pale purplish brown, crossed beyond the middle by a wide primrose-yellow band, which nearly surrounds a large purplish-brown spot near the apex: secondaries semi-hyaline yellow, darkest at the apex and on the outer margin; the fringes of both wings yellow. On the underside of the primaries the brown is replaced with purplish black. The head, abdomen, and legs yellow; the collar, tegulæ, and thorax pale purplish brown.

Expanse $1\frac{1}{2}$ inch.

Hab. Guatemala (*Conradt*, in *Mus. Staudinger*).

Neritos samos, sp. n.

Male.—Primaries very similar to those of *N. psamas*, but much redder in colour; the yellow band crossing the wing narrower, and not surrounding the apical spot, as it does in *N. psamas*: secondaries pale chrome-yellow. Head and thorax reddish brown; antennæ pale brown; abdomen bright red, the underside of the abdomen and legs pale yellow.

Expanse $1\frac{1}{4}$ inch.

Hab. British Honduras (*Mus. Druce*).

Neritos sithnides, sp. n.

Male.—Primaries and secondaries dark brown; primaries crossed beyond the middle by a bright yellow band, which extends from the costal to the outer margin; the outer margin and the fringe of both wings yellow. The head yellow; thorax dark brown; abdomen above bright orange-red, the underside, anus, and legs pale yellow.

Expanse $1\frac{1}{4}$ inch.

Hab. Peru, Rio Napo (*Whitely*, *Mus. Druce*).

Neritos patara, sp. n.

Male.—Primaries pale yellow, slightly hyaline about the middle; the basal third of the wing and a square-shaped spot close to the apex pale brown: secondaries pink, the apex and outer margin edged with brown. The head yellow; antennæ

brown, with the tips yellow; thorax dark fawn-colour; abdomen pink; legs pale brownish pink.

Expanse $1\frac{1}{4}$ inch.

Hab. British Guiana, Essequibo River (*Whitely, Mus. Druce*).

Neritos cutheans, sp. n.

Primaries very similar to those of *N. amastris*, but darker and marked with yellow instead of red, and the outer margin broadly bordered with yellow almost to the anal angle: secondaries white instead of pink. Head and thorax yellowish; abdomen red on the upperside, yellow on the underside; antennæ and legs pinkish brown.

Expanse 2 inches.

Hab. Colombia, Frontino Antioquia (*Salmon, Mus. Druce*).

Phæoptera triphylia, sp. n.

Female.—Primaries and secondaries dull smoky brown, with the veins all black. The head, collar, thorax, and tegulæ bright orange-yellow, the tegulæ tipped and edged with brown on the outer side; the antennæ, palpi, underside of the head, abdomen, and legs all black; the upperside of the abdomen deep black, except the four anal segments, which are bright orange-yellow; a row of bright orange-yellow spots on each side of the abdomen extending from the base to the anus.

Expanse 3 inches.

Hab. Panama, Chiriqui (*Trötsch, in Mus. Staudinger*).

This species is allied to *Lophocampa humosa*, Dogn., from Ecuador, but is at once distinguished from that species by having the underside of the head and thorax black instead of orange-yellow and by the row of orange-yellow spots on each side of the abdomen: also the base of the abdomen is black instead of yellow and the four anal segments are yellow; in *L. humosa* only three are yellow. *Lophocampa humosa*, Dogn., should be placed in the genus *Phæoptera*.

Gnophæla epicharis, sp. n.

Male.—Primaries pale brownish fawn-colour, the veins and the fringe dark brown; a large yellowish-white square-shaped spot at the end of the cell, beyond which nearer the apex are two small spots of the same colour: secondaries pale, shading to dark yellowish brown beyond the middle, the veins and fringe dark brown. The head, antennæ, and thorax

black; abdomen blue-black; the sides of the head and the underside of the thorax bright orange.

Expanse $1\frac{3}{4}$ inch.

Hab. Guatemala (*Conradt*).

A female in Dr. Staudinger's collection is identical with the male, but paler in colour.

Fam. **Lithosiidæ.**

Eudule leopardina, sp. n.

Primaries black, with three bands of red spots crossing from the costal to the inner margin; in some specimens these spots are much more broken than in others; the fringe black: secondaries red; a black spot at the end of the cell and one on the inner margin; the apex and outer margin edged with black. The head, antennæ, thorax, abdomen, and legs black, the abdomen banded with white.

Expanse 1 inch.

Hab. Bolivia (*Mus. Druce*).

Eudule strigilis, sp. n.

Primaries and secondaries chrome-yellow; primaries crossed from the costal margin near the apex to the outer margin by a narrow black band; the apex and outer margin edged with black: secondaries, the apex and outer margin black. Antennæ black; head, thorax, and abdomen chrome-yellow, abdomen banded with black.

Expanse 1 inch.

Hab. Bolivia (*Mus. Druce*).

Fam. **Melameridæ.**

Darna maxima, sp. n.

Male.—Primaries and secondaries dull slate-colour; primaries crossed beyond the middle by a wide pale yellow band, the apex black; the inner side of the band and the costal margin to the base black. Antennæ and legs black; head, thorax, and abdomen greyish black.—*Female* very similar to the male, but larger.

Expanse, ♂ $1\frac{3}{4}$, ♀ 2 inches.

Hab. Bolivia (*Mus. Druce*).

This species is allied to *D. colorata*, Walker, and to *D. inca*, Schaus, but very distinct from either.

Thirmida gigantea, sp. n.

Primaries orange-yellow, the costal margin, veins, and inner margin black; the apex very broadly slate-colour: secondaries semihyaline slate-colour; the veins, costal margin, and apex blackish. The head and antennæ black; thorax, abdomen, and legs slate-colour.

Expanse $2\frac{1}{4}$ inches.

Hab. Bolivia (*Mus. Druce*).

This species is allied to *T. dimidiata*, Walk.

Fam. **Acontidæ**.*Eugraphia splendens*, sp. n.

Male.—Primaries cream-colour; a fine brown line crosses the wing about the middle from the costal to the inner margin, beyond which is a curved row of reddish-brown spots, those nearest the apex being the brightest; two black dots streaked with blue close to the anal angle; a wide fawn-coloured line extends from the apex to the end of the cell, also a marginal fawn-coloured line along the outer margin; the fringe cream-colour: secondaries bright chrome-yellow, with three black spots close to the apex; the fringe cream-colour. Antennæ black; head and thorax cream-colour; abdomen chrome-yellow.

Expanse $1\frac{3}{10}$ inch.

Hab. Ecuador, Guayaquil (*Dolby-Tyler, Mus. Druce*).

This beautiful species is allied to *E. effusa*, Druce, from Sarayacu, but very distinct.

V.—*On some new Pierine Butterflies from Colombia.* By A. G. BUTLER, Ph.D. &c., Senior Assistant-Keeper of the Zoological Department, British Museum.

EARLY in the present year a small collection of insects from Colombia was submitted to the staff of the Department for examination. Among the Butterflies I selected, as desiderata to the Museum series, examples of three species of *Pierinæ* belonging to the genera *Mylothris* and *Pieris*; two of these proved to be undescribed.

MYLOTHRIS (Section *Perrhybris*), Hübn.

I cannot see my way to a generic separation of the New-

and Old-World forms of *Mylothris*; no structural difference which I have been able to discover is constant to all the species. The fact that the New-World forms appear to mimic Heliconidæ, whilst the Old-World forms appear to be mimicked by the genus *Phrissura*, would not of itself be sufficient for a generic definition. In some of the New-World forms the subcostal furca of the primaries is longer than in some of those from the Old World, and *vice versâ*; in some the lower discocellular of the secondaries is transverse, whilst in others it is oblique; the relative distances between the subcostal branches also vary, but the main features of *Mylothris* are retained by all the species.

Mylothris Rosenbergi, sp. n.

♂. Near to *M. lypera*; above milk-white, showing the under-surface markings through the wing-texture; primaries with black apical third and costal border as in that species: secondaries with the outer border black, irregularly indented, distinctly narrower: below the primaries are the same as in *M. lypera*, but the secondaries are white, the basicostal band very faintly tinted with sulphur, and the discal belt, which is much broader than in *M. lypera*, washed with bright sulphur-yellow on its abdominal three-sevenths; the orange streak on the subbasal black band narrow and abbreviated, and the external black border of about half the width of that in the common species.

Expanse of wings 64–68 millim.

Two males, Rio Dagua, Colombia (*W. F. H. Rosenberg*).

Mylothris sulphuralis, sp. n.

♂. Also allied to *M. lypera*, but the apical black area occupying only two fifths of the primaries and less distinctly angulated or notched on its inner edge; outer border of secondaries narrow, as in the preceding species: on the under surface the narrower apical area of the primaries and the sulphur-yellow, instead of orange, streak on the black subbasal (or basi-subcostal) band of the secondaries serve to distinguish it from *M. Rosenbergi*.

Expanse of wings 59–63 millim.

Two males, Rio Dagua, Colombia (*W. F. H. Rosenberg*).

Pieris kiçaha.

Pieris kiçaha, Reakirt, Proc. Ent. Soc. Phil. ii. p. 349 (1863).

Var. *Pieris notistriga*, Butler and Druce, Cist. Ent. i. p. 111; Salvin and Godman, Biol. Centr.-Amer., Rhop. p. 132.

Intermediate between *P. leptalina* (= *pisonis*) and *P. pandosia*, but nearest to the latter; the primaries with wider and less deeply incised black external area above; below with five submarginal white spots; in the secondaries below the brown apical spur is carried, as a subcostal band, to the inner margin close to the base, as in *P. leptalina*.

Expanse of wings 47 millim.

Two males, Rio Dagua, Colombia (*W. F. H. Rosenberg*).

In typical *P. kizaha*, from Honduras, the orange macular submarginal stripe on under surface of secondaries appears to be confined to the apex of these wings, which doubtless led Reakirt to compare his type with *P. marana*.

VI.—*Notes from the St. Andrews Marine Laboratory.*—
No. XVI. By Prof. M'INTOSH, M.D., LL.D., F.R.S., &c.

1. On the Ova, Larval, Post-larval, and Young Forms of *Rhombus maximus*, with Remarks on the Adults in Confinement.
2. On the Ova and Larvæ of *Drepanopsetta platessoides*.
3. On the Spawning-period of *Agonus cataphractus* and the Vitality of its Ova.
4. On the Post-larval Stage of *Crystallogobius Nilssonii*.
5. Note on Injuries to Oysters by Boring Forms.

1. *On the Ova, Larval, Post-larval, and Young Forms of Rhombus maximus, with Remarks on the Adults in Confinement.*

No form has been the cause of greater uncertainty in regard to eggs, larval, and post-larval stages than this species. Yet ripe ova were first obtained during the trawling expeditions in July 1884 in a female of 12 lbs. Neither then, nor in 1892, when Mr. Holt found another ripe female on the pontoon at Grimsby, could a male be procured; but the latter naturalist subsequently was more successful, hatched the fertilized ova, and gave the first accurate account * of the larval fishes, though none lived more than a few days after escaping from the egg. Recently Dr. Canu †, who is carrying out fishery investigations for the French government at the Marine Station of Boulogne-sur-Mer, was able to fertilize the eggs and make a brief note of the development. The perseverance

* Journ. Mar. Biol. Assoc. vol. ii. n. s. p. 399.

† Ann. Stat. Aquic. Boulogne, 1893, p. 131.

of Dr. Fulton and the practical skill of Mr. Harald Dannevig at the Dunbar hatchery of the Fishery Board have at length made it possible to give a more complete account of the development of this important fish. It is remarkable that few, if any, eggs of the turbot are found in our inshore waters either at the surface, in mid-water, or at the bottom; indeed, it is one of the ova that has hitherto escaped capture in the tow-nets of the laboratory, closely allied ova having more than once been mistaken for it. This rarity may be due either to its tendency to sink, after a time, to the lower regions of the water, or to the distance of the spawning-grounds from the coast. The ripe season would seem to extend from the beginning of June to the end of July at least, and probably overlapping both periods.

The ripe ovum of the turbot has an average diameter of 1.0287 millim., and the single oil-globule it contains measures 0.21 millim.* On extrusion the healthy ova are perfectly buoyant, floating at the surface of still water or suspended in mid-water. In some instances, however, at Dunbar many of the eggs went to the bottom, probably because changes had occurred by long retention in the ovaries. The capsule (*zona radiata*) is very distinctly wrinkled both in the fertilized and in the unfertilized condition, indeed quite as much as in the lemon-dab. The oil-globule presents no special tint, and retains a nearly uniform diameter in all the specimens, as Mr. Holt has already noticed. When the eggs were in mass the latter observer was of opinion that the oil-globule gave a faint ochreous hue to the whole. Like other forms these ova are sensitive in the early stages and with difficulty bear a journey, especially in warm weather, and it would be well in such cases to delay transmission until the blastopore has closed.

Ova fertilized at 6 A.M. on the 22nd June were in the multicelled condition at 6 P.M., but the disk showed certain peculiarities, the result of the journey by rail from Dunbar to St. Andrews in glass vessels, thick earthenware jars being much better for transport. Thus many of the marginal cells of the disk were much elevated and the nuclei clearly defined as slightly pinkish bodies by transmitted light. Numerous free nuclei were in the periblast. It seemed as if a somewhat abnormal activity, due to external conditions, had ensued, a view the more probable since the entire series perished before next morning.

Another series of ova, fertilized on June 21st at 5 P.M., and

* Wenkebach gives the diameter of the egg as .75 (*vide* Cunningham).

which bore the journey and the heat more satisfactorily, presented at the twenty-fourth hour, viz. about 5 P.M. on the 22nd, the germinal cavity and shield. As the embryo became outlined next day (23rd) a tendency to the formation of numerous large vesicles, at the ordinary site of Kupffer's, as well as extending forward along the body in groups, was a conspicuous feature. How far this condition was due to the vicissitudes the ova had encountered is an open question, but it was pronounced. On the 24th June the embryo was distinctly outlined with optic vesicles, lenses, cardiac thickening, and other features, while the large vesicles above mentioned were fewer. Moreover in some a series of chromatophores were thickly dotted along the trunk and a few over the brain, but no colour was yet visible under a lens, though the embryo was indicated by a distinct opacity.

On the 25th June the ova presented a slightly reddish hue under a lens. It was also interesting to note that the diameter of some of them had increased in the direction of the long axis of the embryo, so that they were ovoid. The head and body were studded with rounded reddish (ruby-red by transmitted light) chromatophores, some, however, being only slightly tinted; they likewise extended over part of the yolk. The protoplasmic investment of the oil-globule had a few black specks. The otocysts were well formed, the lenses distinct, and the heart pulsated feebly at intervals. The tail had extended considerably beyond the yolk, yet one or two vesicles occurred on the site of Kupffer's. The yolk had a streaked granular aspect, probably from the development of minute vesicles on the blastodermic surface. The notochord was multicolumnar.

Next day the pigment-corpuscles had a darker ruby-red, and black chromatophores had also appeared. The pectoral expansions were distinct, the vesicles had vanished from the ventral aspect of the trunk, while the tail was longer and had a few black chromatophores near the tip. The black pigment at the oil-globule had increased. The pulsations of the heart were more regular. The yolk had considerably diminished, and thread-like processes projected here and there from its margin. Only a few red chromatophores existed on the minute vesicular yolk-sac. The black corpuscles seemed to form a band along the margins of the body superiorly and inferiorly.

On the 27th June the colour under a lens was brick-red, from the branching of both red and black chromatophores. The eyes were somewhat darker and the yolk had still further diminished.

Most of the ova hatched about the sixth or seventh day—the same period being mentioned by Mr. Holt—the larva measuring about 2.2 millim. in length or a little more. The increase in the red pigment was characteristic, the body under a lens having a brick-red hue, with blackish chromatophores scattered over the surface. The rounded reddish chromatophores of the embryo were now (in the larva) much branched on the head, trunk, two caudal bars, and the rectal process, and some had appeared around the oil-globule and at the throat, as well as in the cardiac region. The two brownish bars at the tail had a somewhat triangular or bluntly conical form, and extended from the trunk to the border of the marginal fin. A slight patch also occurred in the latter dorsally, about midway between the caudal bar and the head. The reddish pigment at the rectum passed downward to the termination of the gut and abruptly ceased, a pale strand of tissue being continued from it to the edge of the marginal fin. The heart lay somewhat low in the subopercular region, which was deeply pigmented. The finely ramified black chromatophores covered the entire region tinted reddish, so that only the middle of the yolk-sac was translucent, and even on this were a few much-branched red corpuscles. The ventral surface of the yolk-sac, as well as other parts, had numerous black chromatophores. By transmitted light the reddish parts had a fine ruby-red hue. The eyes had a similar colour, a few dark touches also being present. The abundance of pigment obscured the otocysts and their two otoliths. Even at this stage the larval fishes darted about at intervals, after resting on the bottom or float with the yolk-sac uppermost and the tail inferior. In Mr. Holt's examples the oil-globule was ventral in position, but in ours it occupied a more or less posterior position.

After two days the pigment in the eyes had increased and they were slightly iridescent. The black chromatophores over the body were more abundant, while the bars behind the vent were broader, especially the superior, which almost touched the margin of the fin. The mouth was open and the mandible was prominent. The oil-globule adhered to the remnant of the yolk—nearly in the middle of the abdomen, though slightly variable in position—in some having moved upward and backward with the diminishing yolk.

On the 1st of July the larval turbot evinced greater activity, darting through the water at intervals and again resting on the bottom. The increase in the black pigment rendered the body dusky brown. The two posterior bars had spread out, and finely ramified black pigment existed in both. The mid-

dorsal patch now touched the body-line, and it also presented a few black chromatophores. The same brownish hue tinted the marginal ridge over the head and snout. The black pigment rendered both dorsal and ventral surfaces dark when viewed on edge, two long blackish bands occurring dorsally, separated by the brownish area in the mid-dorsal line. The skin was finely dotted with minute vesicles. The eyes had a greenish iridescent lustre. The marginal fin continued as a prominent border over the vertex to the tip of the snout; this fin was still proportionally broad, though the body had lengthened to fully 3.46 millim. No fin-rays were yet visible in the caudal expansion. Movements of the mandible and of the hyoidean apparatus occurred occasionally. The pectoral fins had considerably increased in size and were used in balancing. The clavicular bar was also evident. The oil-globule was seen with difficulty, but in diminished size; it was, with the remnant of the yolk, in some near the lower border of the abdomen. A feature of moment in these larval turbot was their hardihood, for after exposure on a slide in a few drops of water for two hours they became active when transferred to their vessel.

The yolk was entirely absorbed on the 3rd July, that is about the seventh day. The marginal fin over the head had increased in depth and the black and other pigments had ramified outward in all directions at its inner border. The caudal expansion showed faint embryonic rays. Blood-vessels with pale blood were now observed, *e. g.* the sub-intestinal, coursing upward in front of the rectum and passing towards the liver, and the subnotochordal trunk (aorta), which could be traced backward to the inferior line of pigment behind the posterior brown bars.

With the disappearance of the yolk the turbot may be considered to have attained their early post-larval condition, and they swim throughout the water by rapid strokes of the tail and vibrations of the pectorals. In still water they often remain suspended with the head downward; but there can be little doubt that, like the plaice observed by Mr. H. Dannevig, they would luxuriate with their heads directed to the current in the fresh streams of water either in the open sea or in the apparatus at Dunbar. The body of the little fish was dull reddish (more or less ruby-red) by transmitted light, but by reflected light it had a dull ochreous or pale brownish hue and finely marked with black. The outer margins of the two dorsal patches were paler, and the pigment immediately behind the prominent posterior bars was also pale, these lighter touches being very evident during the vigorous move-

ments of the animals. The abdomen was deeply pigmented all over with black. The head and anterior region were conspicuous both from the great depth of the opercular region and the development of pigment on the abdomen, so that the aspect was somewhat like that of a tadpole. The eyes were greenish silvery. The pectorals were large and fan-shaped, with reddish and black pigment at the base, the latter extending outward into the fin as long branching lines, which resembled very much the ramifications of rivers in a map. The angle of the mandible projected prominently downward, as it were enclosing the anterior hyoidean region in a deep furrow. The vent now gave passage to minutely granular matter.

Besides the movements above noted the little turbot occasionally swam at the surface on their sides, skimming along with rapidity and moving the hyoidean region actively. They were quick in observing the movements of the minute crustaceans and other forms in the vessel, and seemed to dart at them for food. No form hitherto observed at St. Andrews appeared to be more hardy or to undergo the vicissitudes of temperature and manipulation with greater impunity. There are grounds, therefore, for expressing the hope that they may yet be reared in great numbers from the post-larval to the adolescent and adult conditions in suitable enclosures.

Larval turbot are seldom caught in the tow-nets, though from a figure * of Prof. Marion's either this or the brill occurs off Marseilles on the 2nd of March. Mr. Holt, again, was fortunate in procuring at the surface of the North Sea a series of post-larval forms ranging from 5.50 to 16.25 millim. In these the snout is short and obtuse and the angle of the mandible acute. The tail is narrow and the belly prominent in the smallest example. The tail becomes deeper and the abdomen less projecting at 7 millim. At 13 millim. the right eye appears above the ridge. One of the most interesting features is the presence of an armature of spines, best marked in specimens 10-15 millim. long, on the head behind the eye, on the articular region of the mandible, and on the opercular region; these persist till they reach 25 millim., and Mr. Holt has even found traces of them in one example of 175 millim.

Off the east coast of Scotland pelagic specimens $1\frac{3}{16}$ to $1\frac{1}{8}$ inch occur in July, and in August they increase in size and take to the bottom. Thus by aid of a net for capturing sand-eels a series ranging from 41 to 62 millim. were taken at the margin of the estuary of the Eden on the 7th September.

* Ann. du Mus. d'Hist. Nat. Marseilles, iv. 1, pl. ii. fig. 20.

The size, however, was variable, for others taken on the 15th reach only $1\frac{3}{4}$ inch. Increasing in size, they were found 3 inches long close inshore on sandy ground by the same net worked from the land by aid of a boat in the middle of December. In February some were 6 inches, but others in April were only $5\frac{1}{4}$, while one on the 23rd May only reached $2\frac{3}{8}$ inches. The last would seem to have been an example from an egg spawned very late or to have been arrested in growth. As a rule they reach 6 or 8 inches in June, while in September many are captured in 3-5 fathoms from $9\frac{1}{2}$ to $9\frac{1}{2}$ inches, the latter apparently representing the growth from the previous spawning-season, or a period of about fifteen months.

Thereafter the turbot seeks the offshore waters, the deeper parts of which form its home and its breeding-grounds.

This large and active fish presents certain difficulties in regard to voluntary spawning in confined areas—as, for instance, in the ponds at Dunbar. Though apparently at home in the pure sea-water, through which they skim with much dexterity and ease, and readily feeding on herrings and sand-eels, they have hitherto refused either to shed milt or ova without artificial aid; so that the experiment is much less successful than with the plaice, which spawns so freely. Moreover, in confinement the turbot is liable to ulceration of the surface on the opercular region of the right side and on each margin of the same surface at the tail. Such injuries are probably due to friction against the bottom or sides of the pond, and even though the bottom is covered with sand the ulcers have a tendency to form.

When, however, the eggs were obtained and duly fertilized no difficulty was found in hatching them, for the Dannevig apparatus at Dunbar causes a constant and equable movement. Thus the tendency to sink, observed by Mr. Holt and others, is counteracted.

The turbot, like other flat fishes in confinement, are prone to a disease which, in common language, may be called "egg-bound,"—that is to say, though they have pure sea-water, a certain space, the presence of males, and abundant food, yet they refuse to shed their ova. This condition, indeed, was specially referred to in the case of the flounder some years ago*. Though the ovaries are largely distended with ripe ova or ova that have been ripe, occlusion of the ducts by spasm or otherwise prevents their issue, and in some instances causes the death of the fish. In the ovaries of the female

* Third Ann. Report Scot. Fish. Board, 1885, p. 62.

turbot at Dunbar degeneration had taken place to a considerable extent on the 7th September. In the centre of the enlarged ovary was a space filled with glairy mucus, containing degenerating ova which had formerly been fully matured. The mucus was mixed with fatty débris and granules, with shrunken egg-capsules. The fishes were evidently getting rid of the eggs of the season, chiefly by disintegration and absorption, while in the walls of the ovary a crop of minute ova were developing in a healthy condition and having a diameter of about $\cdot 0762$ millim. Between the foregoing date and the beginning of April considerable change had taken place in the ovaries; thus, out of five examples only one had many degenerating ova on the ovarian walls, the capsules being wrinkled, collapsed, and opaque, while the contents consisted of minute granules of yolk and oil-globules which by transmitted light had a slightly yellowish colour. In the majority the capsule had ruptured and permitted the contents to escape. The wall of the ovary itself consisted of rugose laminae, chiefly longitudinal in the elongated posterior region, or slightly oblique anteriorly where trending to the oviduct. These laminae were covered with developing ova, the largest ranging from $\cdot 2286$ to $\cdot 3810$ millim., thus considerably exceeding in size those of September. The anterior region of the ovary appeared to be somewhat thicker than the posterior and the ova slightly larger; but this may have been accidental. The oviduct was occupied by a mass of degenerating ova. Of the other four, three had a few degenerating ova between the folds of the ovaries and one had got rid of the whole. All showed healthy developing eggs in the ovaries, though the size was less than those of the first-mentioned specimen. Under these artificial circumstances, therefore, the retained ova are got rid of very slowly; but such a condition probably never takes place in the sea. It is, at any rate, clear that the environment of the turbot at Dunbar had been favourable for the development of the ovarian ova and that, initial difficulties being overcome, it may yet be possible to retain the spawning fishes from season to season. When they become accustomed to confinement and find themselves in favourable surroundings the "egg-bound" condition, which is voluntary, may disappear.

2. *On the Ova and Larvæ of Drepanopsetta platessoides.*

During the trawling expeditions of 1884 an egg was frequently found in spring, especially during March and April, which was distinguished from all others by the large size of

the perivitelline space—that is, the space within the transparent capsule or zona in the early stages of the egg. It was mentioned in the report on trawling that these ova were one third larger than the majority of the pelagic eggs, and resembled hydropic ova. The latter condition, however, was only apparent, and they were in all respects healthy, the advanced embryo with its yolk-sac lying in the centre of the transparent capsule. These eggs were widely distributed all along the eastern coast from the south of St. Abb's Head to the Moray Firth, so that they evidently belonged to a common species. Though ripe long-rough dabs were seen in the dead condition in March 1884, and the eggs observed to be pelagic, yet, as this occurred during a violent storm, no opportunity was available of doing more than noting their condition, which, on issuing from the ovary, differs, as will by-and-by be shown, from their subsequent state, and thus the connexion between them and the foregoing was not made out. Every season (viz. in March, April, and May) since that date these eggs have been brought in greater or less numbers to the Marine Laboratory and hatched. A figure of the same egg was also shown me by Mr. J. T. Cunningham in 1885, but he likewise had not ascertained the form to which it belonged, for in 1887* he observes that he had not been able to hatch it and that no similar egg had been obtained from an adult fish. Further remarks on the egg and newly-hatched larva were made in the "Pelagic Fauna of St. Andrews Bay"†; the advanced embryo tending to the upper arch of the egg in floating, and presenting along the sides minute yellowish (chrome) and black chromatophores, which in most cases were still unbranched after hatching. In the "Researches"‡ the same egg was again alluded to, and the early post-larval fish figured. It "presents three distinct yellowish bars behind the vent, another at the latter, and a line along the dorsum of the intestine, besides various touches of the same on the head and elsewhere. Stellate black chromatophores occur along with the yellow, and in the early condition are present on the yolk. The eyes soon assume a silvery aspect. The larval fish is active and comparatively large, resembling in certain respects the plaice. It is probably a pleuronectid."

When surveying the fishing-grounds off the west coast of Ireland with Mr. Green and Prof. Haddon in 1891, Mr. Holt

* Trans. Roy. Soc. Edinb. vol. xxxiii. p. 105, pl. vii. fig. 2.

† Seventh Ann. Report Fishery Board for Scotland, p. 270, pl. iii. figs. 1-3 (1889).

‡ Trans. Roy. Soc. Edinb. vol. xxxv. pt. iii. p. 853, pl. xviii. fig. 2 (Feb. 1890).

found that these eggs pertained to the long-rough dab, and thus their comparative abundance was readily explained. A similar relationship had been suspected at St. Andrews, since the ova of almost all the other pleuronectids except the halibut had been examined. These ova are especially abundant on the fishing-grounds to the east of the Island of May. So far as my experience goes they chiefly abound in March, rarely a few occur in February, and in all probability, though nearly ripe, none are discharged before January. Off the west coast of Ireland Mr. Holt found the adults spawning during the same months, viz. from March to the beginning of May.

It is remarkable that the obscurity surrounding the eggs of so common a fish should have remained so long. In a recent Scandinavian work * nothing more definite than hearsay evidence is afforded, though the statement of the fishermen of Bohuslän that the roe runs in February and that the fish is spent by the month of March is near the truth. Moreover, comparatively small specimens, both male and female, attain maturity.

By the energy of Dr. Fulton, Scientific Superintendent of the Fishery Board for Scotland, a large consignment of living specimens was forwarded to the Laboratory in excellent condition this spring, so that an opportunity was given for a re-examination of the development of this species. The ripe females ranged from 7 to $13\frac{1}{4}$ inches, and all were distinctly distended with the enlarged ovaries. Moreover, as they lay on the dark bottom of the tank the prominent ovarian region of the coloured surface was readily distinguishable as a broad pale pinkish streak. Some of the females were also marked with white touches, generally in pairs over the interspinous regions dorsally and ventrally, very much in the position the dark touches hold in the pelagic post-larval forms. The males, on the other hand, were much smaller, ranging from $5\frac{1}{4}$ to $6\frac{3}{4}$ inches in total length, and presenting little or no distention—a fact due to the minute size of the testes, which are wholly confined to the abdominal cavity, and are only about $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in length in a male of $6\frac{3}{4}$ inches. No larger male occurred in this collection, which consisted of nearly sixty specimens, so that the question may be raised as to the reasons for the limitation of the size of this sex and the small size of the male organs.

Most of the females were very ripe, and a considerable quantity of ova escaped on the slightest pressure and fell in

* 'Scandinavian Fishes,' Fries, Ekström, and Sundevall (2nd edit., 1893).

a mass into the water, and then slowly mixed with it. In the experiments made in the laboratory the smallest trace of milt fertilized every egg in the vessels, which were about a foot across, so that the activity of the sperms was characteristic. The quantity of ripe ova discharged at a given time was quite as large in proportion as in the plaice, in the turbot, and in the flounder. Fishes in which the testes are small, as in the torsk, plaice, long-rough dab, and sole, do not appear to differ much, in regard to the rapidity of issue of the ripe eggs, from those with large testes. The small size of the testes in the horse, compared with the large size of the testes in the porpoise, is another instance of the caution requisite in drawing conclusions on this head. At any rate, in regard to fishes the ascertained facts up to date do not seem to warrant strong statements on the subject. The ripe female sole in Scottish waters discharges a considerable number of eggs, and a large number are also emitted by the ripe lemon-dab. The quantity of ripe eggs which issue from a torsk is about as large in proportion as in a cod, yet the testes of the two differ much in size.

The egg of the long-rough dab, on issuing from the oviduct, is beautifully translucent, and measures from 1.0668 to 1.1430 millim. The *zona radiata* clings somewhat closely to the contained yolk, and is wrinkled all over, quite as much as in the lemon-dab. The perivitelline space is small, and thus differs from the condition as ordinarily seen in the tow-nets. As a rule the yolk, or egg proper, has a diameter of 1.0668 millim., while the capsule has a diameter of 1.1430 millim. When placed in sea-water, and whether fertilized or not, a gradual change takes place in the perivitelline space, so that next morning, that is, in twelve hours, the diameter of the capsule is from 1.7907 to 1.8669, probably by the imbibition of water, as in the case of desiccated eggs, while the diameter of the egg proper in the centre remains nearly the same. This distention removes many of the wrinkles from the surface, but not all, since these were visible in almost every example up to the period of hatching. Many of the eggs had groups of minute fatty granules dotted all over the yolk. Next day (22nd March) at 12.30 considerable progress had been made, the disk being in the multicelled condition, the cells of the blastoderm being often prominent, and at 5.40 P.M. much more finely divided. The minute granules of oil occur over the yolk, beneath the protoplasmic investment, and they appeared to be fewer next day, so that probably they were gradually used up in the process of development. The minutely cellular disk presents an inward curvature at its

edge, which is not quite regular, from the occurrence of minute projecting cells. The disk does not always occupy the centre of the yolk under examination. Occasionally a group of large oleaginous globules lies under the developing disk, not at the uppermost pole of the egg.

On the 24th the embryo was outlined, with the optic enlargements. The blastopore in some was almost closed, and Kupffer's vesicle was represented by a few granules or minute vesicles. The notochord formed a pale streak extending forward to the middle of the trunk, and the margins of the body were faintly indicated.

Next day the blastopore had closed and Kupffer's vesicle was large. Numerous muscle-plates had formed and the notochord could be traced forwards almost to the head. On each side a delicate cellular border stretched backward outside the muscle-plates. The granules had now disappeared from the surface of the yolk.

On the 26th March the embryo resembled Mr. Holt's fig. 58, pl. vii. *, and traces of blackish pigment appeared along the body, best seen by placing white paper beneath the specimens. Besides, there are in some the pale precursors of the pigment-specks, which appear blackish by transmitted light. The notochord was visible throughout, the lenses in some were faintly indicated, and the otocysts appeared as elongated thickenings with a longitudinal slit, as in the green cod †. The heart was also distinct. The zona was thin and readily ruptured, even when the egg was carefully lifted.

The following day the blackish pigment formed dark bands, especially when viewed on a white surface, and the next day a faint yellowish tint was visible under a lens. The tail formed a blunt knob projecting beyond the yolk.

The yellowish hue was more distinct on the 30th March. On the head it was somewhat diffused, as the chromatophores had given off branches. The rows of rounded specks along the sides were only faintly tinted. Both yellow and black pigments were present. The latter (black) were very finely ramose on the dorsum of the snout and on the head, as well as behind the otocysts. Distinct muscular twitchings of the body occurred to-day.

On the 1st April the embryo more than stretched across the egg; but in most the pigment corpuscles remained simple. The heart was minutely papillose internally and trumpet-

* "On the Eggs, Larval and Post-larval Stages of Teleosteans," Trans. Roy. Soc. Dubl. v.

† Twelfth Ann. Report Fishery Board for Scotland, pt. iii. p. 219, pl. ii. fig. 8.

shaped. Slow contractions occurred at intervals. Most of the yolk was absorbed, and the alimentary canal formed a pale band in front. The otcysts sometimes differed in size. The day after, most of the yellow chromatophores in some were ramified, so that the colour was diffuse, but in others the pigment-specks remained circular. A few small black points were mingled amongst the yellow along the sides of the body. At this stage the yolk was quite free from pigment.

A few were hatched on 3rd April, and many next day. It is possible that the conditions as regards still water and low temperature may have considerably delayed hatching. A specimen removed from the capsule on the latter date (4th April) differs in some respects from that figured by Mr. Holt, viz. a larva about half a day old, since the pigment is not definitely marked in his sketch. Moreover, the former presented no embryonic rays in the caudal; indeed, these did not appear for some time. Mr. Holt's specimens therefore were probably more advanced at the period of hatching. No mouth is visible and the œsophagus ends blindly in front. With the exception of those on the head the yellow chromatophores are still rounded, though, as a rule, the pigment is branched at or shortly after hatching. In a lateral view the yellow chromatophores are grouped chiefly at the dorsal and ventral margins of the muscle-plates and on the rectum; the tip of the tail is devoid of them. Besides the yellow, very finely ramose black pigment-corpuscles occur on the head and amongst the yellow along the body, but it is not easily seen after the yellow chromatophores become stellate, and in some specimens it is late in appearing. The upper part of the head is chiefly furnished with black pigment. A change must thus ensue before the pigment is grouped into bars, for it is somewhat general at this stage. The lumen of the gut has not entered the oblique portion of the rectum, and the pre-anal region of the marginal fin is small at this stage. A more advanced condition of the pigment was present in a specimen (also removed from the capsule) on the 5th April. Both yellow and black chromatophores are finely branched. The variability in regard to the development of the pigment is further shown in an example three days later, viz. 8th April, in which the pigment has now been grouped in bars—that is to say, at certain parts the extension of the chromatophores is more pronounced than at others. Thus the head and the region of the body proper have yellowish and black pigment, the latter along the dorsal and ventral edges of the muscle-plates, with a special area at the rectum, and three bars behind the latter, that near the tip of the tail being mostly

black, though a few yellow chromatophores are present. The eyes also have pigment-specks; the caudal shows embryonic rays. The yolk has considerably diminished. The otocysts are still elongated from before backward, but present a double outline from the differentiation of the capsule.

The larvæ daily increased in activity and size, and the five groups of chromatophores became very distinct, viz. one on the body over the middle of the yolk, another at the rectum, two conspicuous bars behind the latter (often broken up into a dorsal and a ventral band), and a small fifth near the tip of the tail. In the more advanced and more active larvæ, with the yolk much diminished, the pigment is more continuous. Those with a large amount of yolk swim with a wriggling movement. By reflected light the colour of these larval forms is greenish yellow, and thus it differs from the chrome-yellow of the younger stage. This change of hue appears to be due to the development of the black pigment amongst the yellow. The increase in the size of the pectorals in a few days became marked, and though usually carried more or less obliquely, they were fan-shaped when viewed from above.

The chief changes till the 20th April were the deepening of the marginal fin both dorsally and ventrally and the extension of the chromatophores (both yellow and black) from the line of the body into the marginal fin at the two conspicuous bars behind the vent, and the appearance of stellate black pigment-corpuscles along the ventral edge of the fin. Stellate black corpuscles also occur on the abdomen, and the eyes are bright silvery. The yellow pigment still forms a line over the medulla and the first part of the cord. The caudal pigment-bar is chiefly of black corpuscles, only two or three yellow being present. The pectoral fins are larger and have rays; the upward slant of the mandible and the reduction of the yolk to a small round ball complete the features at this stage.

3. *On the Spawning-period of Agonus cataphractus and the Vitality of its Ova.*

Parnell gives May as the spawning-period of this species. Couch says nothing more than that the spawning-period is stated to be spring; while Day describes a female, 5 inches long, from Southend, in February, as having its comparatively large eggs nearly ripe. In the "Researches" * it was stated that the females caught in the sprat-nets in the Tay

* *Op. cit.* p. 674.

showed nearly ripe ovarian eggs on the 16th December, and that they had a dull golden colour, while the structure of the zona (capsule) is given. The males at the same time showed well-formed sperms. It is added that the species seems to spawn from January (or perhaps December) to April. In the recently published '*Scandinavian Fishes*' the authors observe * that "the males are so rare that neither Krøyer nor Ekström has met with a full-grown example; nor, during late years, has the Royal Museum met with a single example. It is probable that it is only during the spawning-season that they live in so shallow water as to be in any danger from the nets used in shore-fishing. The spawning-season is in spring, in March and April or the beginning of May. We have no information as to the way in which the roe is deposited or the development of the fry." So far as our observations go the males are by no means rare, and they accompany the females into the shallow water, and pass into the estuaries of the Eden and the Tay. The remarks published on the subject have escaped the notice of the authors.

The occurrence of a small mass of ova of this species on 1st October, 1894, considerably extends the spawning-period. It was procured at low water near the pier-rocks at St. Andrews, attached to the root of a tangle. The eggs measured from 1.7526 millim. (.0705 inch) to 1.9050 millim. (.075 inch), showing that the ovarian examples mentioned in the "*Researches*," as, indeed, had often been observed, were nearly ripe. Each egg at this date (1st October) had a large oil-globule and an advanced embryo. The circulation was in active operation on the 27th November, the exterior of the egg being further coated with many parasites. In January and February 1895 the eggs were frozen, and they remained so nearly a month; yet on the 2nd March some of the embryos were alive, and, though the water could not be changed, as the pumping-apparatus was under repair, were safely hatched. The remarkable hardihood of such eggs is in contrast with the pelagic ova, which, as a rule, would have been killed.

The egg-capsule is very tough, and rebounds from the needle under pressure like a ball of india-rubber. Under a low power the torn edge shows layer upon layer of the secretion. It is thus difficult to extrude a perfect embryo.

The larvæ immediately after hatching closely correspond with that captured in the bay and figured by Prof. Prince †. The body is about 7 millim. long, the tail being somewhat

* '*Scandinavian Fishes*,' 2nd edit., 1892, p. 210.

† *Trans. Roy. Soc. Edinb.* vol. xxxv. pl. xviii. fig. 11.

longer than in the sketch, and has embryonic fin-rays. The head has large silvery eyes, with greenish-yellow pigment behind them, and around and below the widely open mouth. The trunk generally is dotted over with the same greenish-yellow pigment (ochreous by transmitted light), which is also present in streaks on the basal region of the pectoral fins, on the yolk-sac, and on the prominent anal cone. The three yellow dorsal patches in the marginal fin are distinctly separated and generally have the distal border opaque white, the first being small and nearly in a line running upward from the posterior border of the vent, the second about the widest part of the fin, and the third about the posterior region of the same dilatation. Opposite the two latter is a corresponding patch ventrally. A similar touch of yellow occurs at the commencement of the tail. Numerous stellate black pigment-spots are present on the yolk-sac, a few on the pectoral, and a series along the dorsal and ventral margins of the body as far as the third patch of yellow on the marginal fin. One or two occur on the border of the marginal fin and a considerable number in the ventral patch of yellow (second) in the latter, while only a very few are found in the dorsal patch opposite it. Two exist in the ventral touch behind the former and only traces in the dorsal patch opposite. One or two chromatophores also occur ventrally in the patch at the root of the tail. The black pigment would seem to be better developed ventrally than dorsally.

In connexion with the appearance of eggs at this period it may be mentioned that on the 10th October a larval form resembling *Cottus* was captured in the tow-net. In general outline it resembled that figured in the "Researches"* (somewhat younger than in fig. 9, pl. xvi.), with the vessels coursing over the yolk-sac. The oil-globule remained at the anterior part of the yolk-sac. Small specks of black pigment occurred along the sides of the body, one set forming a row near the upper lateral region. No distinct coloration was visible on the pectorals. The eyes were iridescent greenish, like the inner surface of *Haliotis*.

Hitherto it has been unusual to get larvæ at this season of the year, so that the deposition of such eggs must have been antedated by some months on this occasion if the interpretation of the nature of the larvæ be correct.

* *Op. cit.*

4. *On the Post-larval Stage of Crystallogobius Nilssonii.*

In a former paper* an unknown elongated post-larval form, with prominent teeth and long pectorals, procured on the 20th July, 1889, was described. A further examination of this young fish, which was only 7 millim. long, shows that in all probability it is the post-larval stage of a male *Crystallogobius Nilssonii*, which at that date had only once been found in Scotland, viz. by Mr. Edward, in a rock-pool at Bauff. The very early stage at which the special sexual characters occur in this species is interesting; yet Dr. Day considered that in the young males the head is more pointed, indeed almost as in the females, in which the jaws are short, straight, and toothless. It is clear, however, that such a statement requires amendment, especially the supposition that the teeth ("canines") are only developed as maturity is reached. In the small example from St. Andrews it was the presence of these characteristic teeth and the shape of the mandible that attracted attention, and yet the larval marginal fin was still present. The description given in the Ninth Report may be supplemented by the remark that in the adult male the pectoral fins are remarkable for their "broad (multiradiate) and somewhat lobate form, with their semicircular muscular root and elongated roundish shape. When expanded the pectoral fins are as deep as the body." In life they are boldly speckled with black on a yellowish ground, the latter being brightest inferiorly. The remarkable coloration of these fins in the post-larval stage is an addition to the series in developing Teleosteans. When the eyes of a fresh form are examined from above they are finely iridescent and greenish blue; even when seen laterally they are silvery with a bluish sheen. Since this specimen was captured Mr. Cunningham has procured many adults of both sexes near the Eddystone Lighthouse, while Mr. Holt has been equally successful off the west coast of Ireland and on the east coast of England. It appears to be generally distributed round British shores, though the adults have not yet been secured here. It is sometimes found in as great abundance in Norway as in the south of England. The authors (Fries, Ekström, and Sundevall) of the recently published work on Scandinavian fishes observe that June is approximately the spawning-season of this species, and the development of the post-larval example would appear to point to May or early June as the probable period on our shores.

* Ninth Ann. Report Fishery Board for Scotland, pt. iii. p. 332.

5. Note on Injuries to Oysters by Boring Forms.

It is well known that oysters, amongst other attacks to which they are subject, suffer extensively from the burrowing habits of an annelid (*Polydora*), as well as from the borings of a sponge (*Cliona*). Such have been referred to in the 'Annals' by Dr. Hancock and others, as well as the writer. Both forms chiefly attack the upper (convex) valve, which they by-and-by penetrate, rendering its interior unsightly by dark blotches or excrescences. In the case of the Whitstable "native" this is a serious blemish in the interior of the otherwise pearly white valves, the latter feature having been generally looked upon as the distinguishing characteristic of this favoured oyster. It has sometimes been supposed that such inroads, both of annelid and sponge, are due to the impurity of the water caused, for instance, by the dredgers of the Thames depositing their débris in the proximity of the beds. While the latter is objectionable for various reasons, a glance at the habits of the chief depredators makes it probable that the cause just mentioned has little to do with the attacks. Both annelid and sponge perform the functions of universal destroyers of dead shells, calcareous and other rocks, even in very pure water, inshore and offshore. At Whitstable* the chief enemy is *Polydora*, which propagates in the usual manner by eggs and free-swimming larvæ, the latter occurring in great numbers throughout a considerable part of the year. The purer the water the greater the probability, therefore, that these larvæ will settle on fresh sites and extend the colonies of borers. At the same time *Polydora* is partial to inshore localities in which a considerable amount of mud is present in the currents.

It is not easy to get rid of the annelids after they have tunnelled the shells. Even though every oyster were to be treated in a solution, it is clear that what would kill the annelid would also endanger the oyster. It is satisfactory, however, to know that while the marks on the interior of the valves are unsightly, they do not interfere with the qualities of the oyster as food, nor should they be an objection to the serving of the mollusk in the convex valve, as now obtains in London and elsewhere.

* I have to thank Mr. Sibert Saunders for specimens of these.

VII.—*Descriptions of new Reptiles and Batrachians obtained by Mr. Alfred Everett in Celebes and Jampea.* By G. A. BOULENGER, F.R.S.

Cylindrophis isolepis.

Diameter of eye two fifths its distance from the nostril; distance between the eyes equal to the length of the snout. Rostral a little deeper than broad, separating the nasals, in contact with the præfrontals; frontal a little larger than the supraocular, considerably larger than the parietals, as long as its distance from the end of the snout; six upper labials, third and fourth entering the eye. 22 scales round the body; no enlarged ventrals; subcaudals 5. Black, each scale with a fine whitish edge; belly with two alternating series of large white blotches; lower surface of tail orange.

Total length 430 millim.

A single specimen from Jampea Island.

Calamaria nuchalis.

Rostral broader than deep, its upper portion as long as its distance from the frontal; frontal once and two thirds as long as broad, thrice as broad as the supraocular, as long as the parietals; one præ- and one postocular; diameter of the eye greater than its distance from the mouth; five upper labials, third and fourth entering the eye; two pairs of chin-shields in contact with each other, the anterior in contact with the symphysial. Scales in 13 rows. Ventrals 135; anal entire; subcaudals 16. Tail ending in an obtuse point. Dark brown above, with small round black spots; head dark brown above, speckled with black; nape yellowish, with two large black blotches; a black lateral streak, running along the second row of scales; outer row of scales white; belly white, with a black dot at the outer end of each ventral; tail with three or four yellow blotches on each side; subcaudals white, with a black line between them in the posterior half of the tail.

Total length 180 millim.; tail 15.

S. Celebes; a single male specimen.

Calamaria curta.

Rostral small, nearly as deep as broad, its upper portion hardly half as long as its distance from the frontal; frontal

once and two thirds as long as broad, twice as broad as the supraocular, much shorter than the parietals; one præ- and one postocular; diameter of the eye greater than its distance from the mouth; five upper labials, third and fourth entering the eye; two pairs of chin-shields in contact with each other, the anterior in contact with the symphysial. Scales in 13 rows. Ventrals 154; anal entire; subcaudals 14. Tail ending in a point. Olive-brown above, each scale with a black basal spot; head uniform; two outer rows of scales white, black at the base; ventrals black at the base, white on the border; subcaudals white.

Total length 315 millim.; tail 15.

S. Celebes, 2000 feet; a single female specimen.

Calamaria gracilis.

Rostral a little broader than deep, its upper portion about half as long as its distance from the frontal; frontal once and a half as long as broad, twice as broad as the supraocular, much shorter than the parietals; one præ- and one postocular; diameter of the eye equal to its distance from the mouth; five upper labials, third and fourth entering the eye; two pairs of chin-shields in contact with each other, the anterior in contact with the symphysial. Scales in 13 rows. Ventrals 211-235; anal entire; subcaudals 10-13. Tail rounded at the end. Grey-brown above, with small black spots; outer row of scales white, black at the base; ventrals white, black on the outer edge, with a continuous or interrupted median series of small black spots.

Total length 320 millim.; tail 8.

S. Celebes, 2000 feet; one female specimen. Bonthain Peak, 6000 feet; two specimens, male and half-grown.

Lachesis fasciatus.

Snout slightly turned up, with strong canthus. Rostral broader than deep; nasal entire; upper head-scales small, imbricate, smooth on the snout and between the eyes, obtusely keeled on the occiput; supraocular large; internasals large, separated from each other by one scale; 6 scales in a transverse series between the supraoculars; two postoculars and a subocular, which is separated from the labials by one series of scales in front and two behind; 9 or 10 upper labials, first fused with the nasal, second forming the anterior border of the loreal pit, third largest; temporal scales obtusely keeled. Scales rather feebly keeled, in 21 rows. Ventrals 162; anal entire; subcaudals 60 pairs. Tail feebly prehensile. Grey-

brown above, with numerous dark olive cross-bands, most of which are broken up on the vertebral line, their moities alternating; head uniform dark olive; whitish beneath, closely speckled with dark brown.

Total length 455 millim.; tail 80.

Jampea Island; a single specimen.

Sphenophryne variabilis.

Tongue large, oval, entire. Snout short, rounded, with feebly marked canthus; interorbital space broader than the upper eyelid; tympanum feebly distinct, two thirds or three fourths the diameter of the eye. Tips of fingers dilated into very large disks; first finger shorter than second; toes short, free, the disks much smaller than those of the fingers; no subarticular or metatarsal tubercles. Skin smooth. Coloration very variable. Grey, brown, purple, pink, or crimson above, uniform or with darker marblings, or with a lighter yellow or pink lateral streak; a light vertebral line sometimes present; sides of head usually dark brown; a dark, light-edged ocellus may be present on the lumbar region; beneath uniform whitish, or greyish with yellow spots, or dark brown with yellow spots.

From snout to vent 28 millim.

Bonthain Peak, Celebes, 5000-6500 feet; numerous specimens were collected by the Drs. Sarasin and by Mr. A. Everett.

VIII.—*Animal Temperature as a part of the Problem of Evolution.* By M. QUINTON*.

I.—THE temperature which governs the chemical reactions of life depends upon two factors—(1) the temperature of the surrounding medium, (2) the calorific power proper to the animal. The temperature of the surrounding medium in this respect is of such importance that the isocrymal lines or the lines of greatest cold are confused with the lines indicating the distribution of species on the surface of the globe.

Fossil flora discloses the fact that the temperature of the globe has been always on the decline; in ancient epochs it was very high. We must therefore ask under what thermic conditions the chemical phenomena of life were carried on,

* From the 'Comptes Rendus,' tome cxxii. pp. 850-853 (1896).

and how they have been kept up in the colder epochs which have succeeded.

II.—The chemical phenomena of life were at first manifested under very high temperatures; in addition to the proofs furnished by a study of the flora I would add the following:—The invertebrates, the first vertebrates, had a heat-producing power which might be reckoned as *nil*, or, at least, very feeble. Though they were animals of low chemical temperature, I consider that they confirm by this very absence (of heat-producing power) the conditions of high temperature under which they lived. A heat-producing capacity capable of raising their temperature above that of the surrounding medium was wanting, for the simple reason that there was no need for it.

Figures lend still further probability to this life at high temperatures. The silkworm nurseries are kept at 40° ; the tortoise can withstand a stove-heat of 40° ; Spallanzani and Sonnerat have trained certain fish not only to live but to reproduce their kind at 40° – 44° ; M. Marey cites the case of a *Gymnotus* which thrived at 41° ; a python incubates at $41^{\circ}\cdot5$ (Valenciennes): all which temperatures would, as is known, be rapidly fatal to man.

These invertebrates and primary vertebrates in our day lead but a very precarious life outside of the tropics. They do not survive the first frosts of autumn or become torpid; the chemical phenomena of life are suspended, the venous and arterial blood of the hibernating reptile become mingled. Their very survival is to be explained by a modification of their chemical processes; in the laboratory, mammalian pepsine is only active on food at a temperature of about 38° , reptilian pepsine is still active at 0° .

III.—The first animals lived, then, by the high temperature which they received from their environment. What did life become as this temperature fell? Two logical hypotheses present themselves:—

A. Either life continued at the temperature of the surrounding medium. In this case it modified the reactions of its chemical phenomena and adapted them to the lower temperatures (cold-blooded animals, reptilian pepsine).

B. Or it attempted to maintain artificially the temperature of its chemical phenomena, and to this end created for itself a function which gave rise to the production of heat. In this case life must always submit to the general law of adaptation

and lower progressively in each new species the temperature necessary for the production of its chemical phenomena.

Thus theoretically:—(1) The heat-producing function took its origin in the cooling of our globe, it accommodated itself to and *only increased with it*; (2) the chemical temperatures, in ancient times very high, have always decreased, either in order to produce equilibrium or to adapt themselves to the surrounding medium.

We may thus divide existing animals into two groups—one making its appearance on the globe in ancient times, the other in modern. The ancient group having ceased its evolution at epochs still but little cooled, has theoretically only acquired a feeble heat-producing power. The animals of this group which have been continued to our times (such as the Monotremata, Marsupialia, Edentata, Amphibia, Chiroptera, and hibernating animals) ought *à priori* to exhibit a very feeble heat-producing power, the *feebleness being proportional to their antiquity*.

The chemical temperature being dependent upon two factors (the surrounding medium and the heat-producing capacity), the actual temperature of these animals, *à priori* very low, ought to form a scale of species in the order of their appearance on the globe.

Empiricism accords with theory. I take the first two figures of the list which follows from a recent work by M. R. Semon; the rest are my own:—

Ornithorhynchus, 25° at an external temperature of 20°; *Echidna*, 30° at 19°; *Opossum*, 33° at 20°; *Armadillo*, 34° at 16°; *Hippopotamus*, 35°·3 at 11°; *Myopotamus* (*Coyote*), 35°·5 at 20°; *Vampire*, 35°·5 at 18°; *Elephant*, 35°·9 at 11°; *Marmot*, 37°·3 at 20°; *Llama*, 37°·6; *Ass*, 37°·7; *Camel*, 37°·9; *Horse*, 38°.

In the group of animals whose date of appearance on the globe is recent, on the contrary, the animal having prolonged its evolution into the cold period will have gradually acquired a higher heat-producing capacity tending to the maintenance of the ancient high vital temperatures. These will only have fallen in consequence of adaptation to environment; in this group their fall will be a measure of their recentness.

It is this which confirms the following list. Some of the temperatures are the result of single observations; the observers are different; their absolute value is very restricted, but suffice to confirm the induction:—

Bird, 42°; ox, 40°; hare, 39°·7; pig, 39°·7; rabbit, 39°·6; eland, 39°·4; she-goat, 39°·3; dog, 39°·3; cat, panther, 38°·9; squirrel, 38°·8; rat, 38°·1; monkey, 38°·1; man, 37°·5.

The indications of these two lists are in an inverse direction. In the first the fall of temperature results, so far as the animal is concerned, from the feebleness of its heat-producing capacity, a feebleness proportional to its antiquity ; in the second from its adaptation to the environment, an adaptation proportional to its recentness.

IV.—There results from this empiricism confirming the induction :

(1) That life in its evolution accommodates itself to the cooling of our globe ; that it began at very high temperatures, that at first it had for its chemical medium no other temperature than that of the surrounding medium.

(2) That as the temperature fell the heat-producing capacity came into existence ; its origin becomes clear ; the heat-producing capacity, a function of cooling, determines with the animal temperatures the order of the appearance of species ; lastly, that the class Mammalia is not composed solely of so-called warm-blooded animals, but that it comprises a whole group which may truly be called cold-blooded.

IX.—On a small Collection of *Lepidoptera* sent from Nyasa in 1895 by Mr. R. Crawshay. By ARTHUR G. BUTLER, Ph.D. &c.

ALTHOUGH the present consignment includes only one new species, it is exceptionally interesting, not only as comprising several links between described species, but on account of the important additional evidence afforded by the careful dating of the captures ; so that now it is possible, by comparing these with Mr. Crawshay's previous consignments, to prove conclusively that several very distinct forms declared to be seasonal and conspecific occur together repeatedly in various months of the year—that, in fact, they are not confined to any particular season, and have no more evident claim to be called forms of one species than our European *Vanessa c-album* or *V. polychloros* have to be called forms of *V. urticae*.

1. *Melanitis leda*, var. *solandra*.

Papilio solandra, Fabricius, Syst. Ent. p. 500 (1775).

Deep Bay, W. coast of Lake Nyasa, Feb. 14th, 1895.

“ Dusky brown Thicket, eyed upper wing. Delicate, almost impossible to kill a perfect specimen ” (*R. C.*).

Said to be unquestionably the wet-season form of the following. It would appear that the climate of Nyasa must be as variable and uncertain as that of England!

1 a. Var. *fulvescens*.

Cyllo leda, var. *fulvescens*, Guenée in Maillard's 'Réunion,' ii., Lép. p. 15 (1863).

Lipembi, W. coast of Lake Nyasa, Feb. 22nd, 1895.

"Dusky brown Thicket. A curious insect of owlsh habits, frequenting the gloom of thick covert, and not taking wing in the daytime unless disturbed; flies at dusk" (*R. C.*).

2. *Charaxes flavifasciatus*.

Charaxes castor, var. *flavifasciatus*, Butler, P. Z. S. 1895, p. 251.

Upper Leya, 6 miles N.W. of Deep Bay, W. coast of Lake Nyasa, March 3rd, 1895.

"Dark brown, blue and gold Admiral. Taken feasting on fresh leopard's excrement about half a mile beyond where I captured the large Azure" (*R. C.*).

3. *Charaxes saturnus*.

Charaxes saturnus, Butler, P. Z. S. 1865, p. 624, pl. xxxvi. fig. 1.

♂, Deep Bay, Feb. 13th, 1895.

"Large light brown barred Admiral with two tails. Taken feasting on freshly killed lion-skin" (*R. C.*).

4. *Charaxes guderiana*.

♂. *Nymphalis guderiana*, Dewitz, Nova Acta Akad. Naturf. Halle, 1879, p. 200, pl. ii. fig. 18.

♀. *Charaxes guderiana*, Butler, P. Z. S. 1893, p. 648; Trimen, P. Z. S. 1894, pl. v. fig. 8.

Henga, W. of Lake Nyasa: ♂, Jan. 28th; ♀, Feb. 1st, 1895.

Mr. Crawshay calls the male the "Indigo Admiral," and the female, which contained "25 large and light green fully developed eggs," he describes as "Large light-brown-barred Admiral with four tails."

5. *Charaxes ethalion* (Eastern type).

♀. *Charaxes ethalion*, Boisduval, Voy. de Deleg. ii. p. 593 (1847).

♂, Upper Leya, 6 miles N.W. of Deep Bay, March 3rd, 1895. Mrali, 25 miles N. of Deep Bay, Feb. 22nd, 1895.

"Dark green Admiral with two tails: a foul feeder" (R. C.).

Mr. Crawshay incorrectly calls this a female; it is unquestionably a male.

6. *Charaxes Bohemani*.

Charaxes Bohemani, Felder, Wien. ent. Monatschr. iii. p. 321, pl. vi. fig. 3 (1859).

♂, Upper Leya, 6 miles N.W. of Deep Bay, March 3rd, 1895.

"Giant Azure Blue (Admiral?). Very rarely met with, and almost impossible to take unless when indulging its foul appetite for putrid flesh or excrement. This specimen I took feeding on leopard's excrement at the side of the path in open forest" (R. C.).

7. *Charaxes varanes*.

Papilio varanes, Cramer, Pap. Exot. ii. pl. clx. figs. D, E (1779).

♀, Mrali, W. coast of Lake Nyasa, March 2nd, 1895.

"Burnt-umber and pearl" (R. C.).

8. *Panopea heliogenes*, sp. n.

The largest species of the *P. lucretia* group hitherto received: in form nearest to *P. protracta*, in pattern nearer to *P. expansa*, but the arched belt across the centre of the primaries narrower, more nearly approaching that of *P. comorana*; this and the subapical macular band pale buff, but the submarginal spots on all the wings nearly pure white; the patch at centre of inner margin of primaries and the whole central area of secondaries buff, washed with deep ochreous; the veins crossing the ochreous area partly white and partly black: body black, boldly spotted with snow-white; under surface very similar to *P. protracta*, but altogether yellower.

Expanse of wings 90 millim.

♀, Deep Bay, west coast of Lake Nyasa, Feb. 7th, 1895.

Mr. Crawshay calls this the "yellowish-brown under-winged Fritillary."

9. *Euralia Wahlbergi*.

Diadema Wahlbergi, Wallengren, Kongl. Sv. Vet.-Akad. Handl., Lep. Rhop. Caffr. p. 27 (1857).

♂, Ngerenge Plains, W. coast of Lake Nyasa, Feb. 24th, 1895.

"Black and white Emperor" (R. C.).

9 a. Var. *Papilio dubius*.

Papilio dubius, Beauv. Ins. Afr. Am. p. 238, pl. vi. figs. 2 a, b (1805).

♀, Ngerenge Plains, W. coast of Lake Nyasa, Feb. 24th, 1895.

"Black, white, and yellowish-brown Emperor" (*R. C.*).

9 b. ♀ var. = *E. Drucei*, but larger and with white central area to hind wings.

Ngerenge, Feb. 27th, 1895.

9 c. ♂ var. = *E. mima*, but smaller, and with partly white central area to hind wings, as in *E. Drucei*.

Ngerenge Plains, W. coast of Lake Nyasa, Feb. 24th, 1895.

The four forms of *Euralia* here enumerated represent the most interesting series hitherto received from Nyasa. Mr. G. A. K. Marshall tells me that *E. mima* and *E. Wahlbergi* have not only been taken *in copulâ* in S. Africa, but have both been bred from a series of similar larvæ taken from the same tree; yet not only are they wonderfully dissimilar in pattern and colouring, but whereas *E. Wahlbergi* is represented by a Western form very like itself, *E. mima* does not occur on the west coast. On the other hand, *E. dubius* is a common Western type which varies considerably, but does not occur in South Africa, whilst in Nyasa the whole of the Western and Southern forms (with the exception of the Western representative of *E. Wahlbergi*) occur together. The whole question of the distinctness of species in this, as in many other groups, becomes very complicated, more especially when it is evident that the distinctions are not seasonal.

10. *Hypolimnias misippus*.

Papilio misippus, Linnæus, Mus. Lud. Ulr. p. 264 (1764).

♂, Deep Bay, W. of Lake Nyasa, Jan. 1st, 1895; 2 ♀, Mtambwi, foot of Nyika Plateau, Feb. 4th.

The male is labelled "Purple Emperor," the females "Black-veined and white and black Brown" and "Black-veined Brown," the latter being the *H. inaria* variety, resembling *Limnas Klugii*.

11. *Junonia pelasgis*.

Vanessa pelasgis, Godart, Enc. Méth. ix., Suppl. p. 820 (1823).

Var. *Junonia chapunga*, Hewitson, Exot. Butt. iii., *Jun.* pl. i. figs. 2, 3 (1864).

♂, Kwereru Hill, Deep Bay, April 22nd, 1895; ♀, foot of Jakwa Mountain, Nkamanga, Jan. 28th, 1895.

"Dusky Tortoiseshell. Impossible almost to take a perfect specimen" (*R. C.*).

The specimens now sent completely link *J. chapunga* to *J. pelasgis*.

12. *Junonia cuama*.

Junonia cuama, Hewitson, Exot. Butt. iii., *Jun.* pl. i. figs. 4, 5 (1864).

Kondowi, Lower Nyika, April 6th, 1895.

I have recently been assured that this is an extreme dry-season form of *J. simia*, Willgr., and that my *J. Trimeni* is a form produced between the wet and dry seasons. Before this can be accepted it will have to be proved by breeding, for the evidence offered by dated specimens distinctly contradicts the assertion. I am beginning to have very serious doubts as to the reliability of the evidence upon which many of the so-called "seasonal forms" are associated. In the Museum series we now have twelve examples of *J. cuama*, half of which are labelled with the dates of capture—January, April, September, and December. Of *J. Trimeni* we have nine, all dated, as follows:—January, February, July, December. Of *J. simia* we have fifteen, of which five are dated—January, April, July, and December. Therefore it is absolutely certain that the supposed extreme dry- and wet-season forms occur in perfect condition simultaneously in January, April, and December, and that the intermediate and wet-season forms occur together in January, July, and December. Whenever we have received carefully dated collections from scrupulously accurate collectors I have invariably found that they tended to disprove most conclusively the assertions incessantly made as to seasonal di- or polymorphism. In hardly any instances are these assertions supported by careful experiments in breeding; but, so far as I have been able to judge, they appear to have been based solely upon the dates at which certain forms happen to have occurred in quantity. We will, for the sake of example, assume that *Vanessa urticae* occurred in quantities in June and *V. polychloros* took its place in October (I do not pretend that they do so): the exponent of seasonal dimorphism would immediately declare that *V. urticae* was the dry-season form of *V. poly-*

chloros. I firmly believe that many of the forms now being associated under the term seasonal, when bred, will prove to be infinitely more distinct than our *Vanessa urticae* and *V. poly-chloros*.

13. *Junonia Trimeni*.

Junonia Trimeni, Butler, P. Z. S. 1893, p. 651, pl. lx. fig. 4.

♂, Kambwiyi, Lower Nyika, Jan. 21st; Mtambwi, foot of Nyika plateau, Feb. 4th, 1895.

"Salmon-coloured Tortoiseshell" (*R. C.*).

14. *Junonia aurorina*.

Junonia aurorina, Butler, P. Z. S. 1893, p. 651, pl. lx. fig. 3.

Kambwiyi, Lower Nyika, Feb. 2nd, 1895.

It is quite possible that this may be an early season form of *J. tugela*, a specimen of which Mr. Crawshay obtained on the Nyika Plateau in September 1893; this would not require a great stretch of imagination, because the chief distinctions between the two forms consist in the outline of the anterior wings. Nevertheless, without stronger evidence they must for the present be considered distinct.

15. *Junonia artaxia*.

Junonia artaxia, Hewitson, Exot. Butt. iii., *Jun.* pl. i. fig. 6 (1864).

♂, Ndara, W. coast of Lake Nyasa, March 2nd; ♀, Chifumya, Lower Nyika, April 20th, 1895.

J. Nachtigalii is said to be undoubtedly the wet-season form of this species. In the Museum we have *J. artaxia* collected in Nyasaland in January, March, April, July, and December, but *J. Nachtigalii* only in July. I do not know how these dates will bear out the assertion, but it is certain that fine examples of both types are obtainable in July.

16. *Protogoniomorpha aglatonice*.

Vanessa aglatonice, Godart, Enc. Méth. ix. p. 299 (1819); Lucas, Lep. Exot. pl. lvii. fig. 2 (1835).

♂, Ngerenge Plains, W. coast of Lake Nyasa, Feb. 24th; Deep Bay, March 14th, 1895.

"Pearl-grey. A rare insect in these parts and very hard to take. Enclosed specimen (the Deep Bay example) taken feeding on cattle manure" (*R. C.*).

17. *Pyrameis cardui*.

Papilio cardui, Linnæus, Faun. Suec. p. 276 (1761).

Deep Bay, Feb. 4th, 1895.

"Painted Lady" (*R. C.*).

18. *Metacrenis Crawshayi*.

Crenis Crawshayi, Butler, P. Z. S. 1893, p. 654, pl. lx. fig. 5.

♂, Karora, 9 miles N.W. of Deep Bay, March 3rd, 1895.

"Plum-coloured Fritillary. Rare and difficult to catch, as it perches high; taken in open forest" (*R. C.*).

19. *Euphædra neophron*.

Romaleosoma neophron, Hopffer, Ber. Verh. Ak. Berl. 1855, p. 640:

Peters's Reise n. Mossamb. Zool. v. p. 386, pl. xxii. figs. 1, 2 (1862).

♂, Kaporu, Songwi River plains, Feb. 25th; Upper Leya, 6 miles N.W. of Deep Bay, March 3rd, 1895.

"Light blue, gold and black Admiral. A lover of dark cool shades" (*R. C.*).

Both specimens a good deal worn; they belong to the greenish variety figured by Hopffer.

20. *Eurytela dryope*.

Papilio dryope, Cramer, Pap. Exot. i. pl. lxxviii. figs. E, F (1779).

Mtambwi, foot of Nyika plateau, Feb. 4th, 1895.

"Orange-belted Tortoiseshell" (*R. C.*).

21. *Byblia vulgaris*.

Hypanis ilithyia, var. *vulgaris*, Staudinger, Exot. Schmett. p. 106 (1884-88).

Mrali, 25 miles N. of Deep Bay, Feb. 22nd, 1895.

This species occurs in January, February, June, November, and December, according to the collector's dates on our specimens. It is supposed to be a varietal form of *B. ilithyia* in Africa. Our African examples of the latter were obtained in January, November, and December, but most of them are not dated. From Arabia we have one labelled June; from India, however, they are dated April, May, and October. I believe *B. acheloia* is supposed to be the extreme development of the dry-season form in South Africa. The puzzle to me is, Why should a species common to India and Africa produce totally different varietal forms in the two countries? As *B. vulgaris* only occurs in Africa, it can therefore only be supposed that

in India the species produces two dry-season forms—*B. ilithyia* and *B. simplex* *. But the question most difficult of explanation, as it seems to me, is—How can two forms be called seasonal when they occur at the same season?

22. *Acræa caldarena*.

Acræa caldarena, Hewitson, Ent. Month. Mag. xiv. p. 52 (1877).

♀, Henga, W. of Lake Nyasa, Feb. 1st, 1895.

"Black-tipped dusky Fritillary" (*R. C.*).

23. *Acræa egina*.

Papilio egina, Cramer, Pap. Exot. i. pl. xxxix. figs. F, G (1776).

Lumpi River, Lower Nyika, Feb. 2nd, 1895.

"Large rose and black Fritillary" (*R. C.*).

24. *Catopsilia florella*.

♀. *Papilio florella*, Fabricius, Syst. Ent. p. 479 (1775).

♂ ♀, taken in *coitû*, Mrali, March 2nd; ♀, Henga, Jan. 22nd, 1895.

"Yellow Brimstone" (*R. C.*).

Mr. Crawshay evidently supposed the bright-coloured sex to be the male, and labelled accordingly; in this, of course, he was mistaken.

Var. *Colias pyrene*.

Colias pyrene, Swainson, Zool. Ill. i. pl. li. (1820).

♂ ♀, taken in *coitû*, Mrali, March 2nd (the female contained a "large number of white pointed eggs").

"Green Brimstone" (*R. C.*).

25. *Teracolus anax*.

Callosune anax, H. Grose Smith, Ann. & Mag. Nat. Hist. ser. 6, vol. iii. p. 125 (1889); Rhop. Exot. i., *Call.* pl. i. figs. 5-8 (1889).

♀, Henga, 3200 feet, west of Lake Nyasa, Jan. 22nd, 1895.

"Violet-tipped White ♀" (*R. C.*).

T. anax is said to be a wet-season form of *T. regina*. I very much doubt the existence of *T. regina* in many of the localities frequented by *T. anax*; the latter flies in January,

* Most of our examples of the latter, if not all, were captured in February. I am told, however, that the seasonal forms in India are less marked than in Africa.

February, and October in Central Africa, according to our dated specimens. *T. regina* does, however, occur in the dry season.

26. *Papilio demoleus*.

Papilio demoleus, Linnæus, Mus. Lud. Ulr. p. 214 (1764).

♂, Henga, W. of Lake Nyasa, Jan. 26th, 1895.

"Large yellow and black velvet Swallow-tail" (*R. C.*).

27. *Papilio leonidas*.

Papilio leonidas, Fabricius, Ent. Syst. iii. 1, p. 35 (1793).

♀, Foot of Jakwa Mountain, Henga to Nkamanga, Jan. 23rd, 1895.

"Turquoise and Black" (*R. C.*).

28. *Papilio pseudonireus*.

Papilio pseudonireus, Felder, Reise der Nov. Lep. i. p. 94 (1865).

2 ♂, Kantorongondo Mountain, 5900 and 6975 feet, Nyika, April 15th and 16th; ♀, Cheni-Cheni Mountain, 6100 feet, Nyika, April 17th, 1895.

"Blue and black Swallow-tail" (*R. C.*).

X.—On a new Generic Distinction between the Scorpions of the Genera *Scorpio* and *Palamnæus*. By R. I. POCKOCK.

IN the Ann. & Mag. Nat. Hist. for 1876, vol. xvii. pp. 12-13, Dr. Thorell split the large black scorpions of tropical Africa and Asia into two sections, proposing for the African and Indian species the term *Pandinus*, characterized by the thinness of the inner border of the hand, and for some species inhabiting Indo-Malaya, characterized by the thicker and more rounded appearance of this border, the term *Palamnæus*. Since, however, *africanus* of Linnæus is the type of *Pandinus* and also the type of *Scorpio*, most of Thorell's successors have, on the grounds of priority, adopted the latter title in preference to the former; while *Palamnæus*, of which the type is *Petersii*, Thor. (probably identical with *spinifer*, Hempr. & Ehrb., and possibly with *longimanus*, Herbst), has been allowed to remain as symbolizing a more or less accurately definable form. The character, however, upon which *Palamnæus* was based cannot be said to be of very

great value; and since Prof. Kraepelin has recently shown that the species referred to *Palamnceus* are in reality more nearly allied to the Indian species of *Scorpio* than the latter are to the African species of this genus, it is probable that all arachnologists will be content to abide by his decision that the thickness of the inner edge of the hand in *longimanus* and its allies is not of sufficient value to be accorded generic rank. Prof. Kraepelin, in fact, regards all the species referred by Thorell and others to *Scorpio* or *Pandinus* and *Palamnceus* to the genus *Scorpio*, which therefore extends over tropical Africa, India, Ceylon, Burma, Siam, Sumatra, Java, and Borneo; but at the same time he points out that the species involved fall into two divisions, based upon a structural feature which, as is so often the case, coincides with the division that would be drawn upon geographical grounds. The African forms, for example, are recognizable from the Asiatic* by the presence on the posterior side of the lower surface of the brachium of the chela of a ridge, in front of which run two or more rows of piliferous pores, this ridge and the definite rows of pores being hardly perceptible in the Asiatic species. This character Prof. Kraepelin does not look upon as of generic importance.

Whilst engaged, however, in investigating the remarkable stridulating-organs presented by the scorpions of this section †, I discovered that these organs furnish a valuable additional distinctive character between the Ethiopian and Oriental species. In each case the instrument consists of a cluster of spiniform notes and of an adjacent area of granules, which, by being rubbed against the tips of the notes, throw them into a state of vibration; and in both cases the organ is situated between the basal segment of the chela and the corresponding segment of the first walking-leg. But, as the late Prof. Wood-Mason pointed out ‡, the cluster of notes in the Indian species is situated on the coxa of the chela and the granular area on the coxa of the first leg. I find in the African species, on the contrary, that the notes are placed upon the maxillary process of the first leg and the cluster of granules upon the coxa of the pincer. These organs, it seems, may well be regarded as of generic importance; and in this case the term *Scorpio* must, of course, be retained for the African

* With the exception of the so-called Sumatran species *pallidus*, which has the characters of the African forms. But if my suggestion respecting the locality of this species prove correct, this apparent exception will fall to the ground (*vide* Ann. & Mag. Nat. Hist. (6) xvii. p. 435, in note).

† For descriptions and figures of these organs see 'Natural Science,' July 1896.

‡ Proc. Ent. Soc. Lond. 1877, pp. xviii, xix.

species, while to all the Asiatic forms that present the instrument discovered by Wood-Mason, Thorell's name *Palamnæus* may be applied, though the definition of the genus will have to be entirely altered and the original character upon which it was based wholly ignored.

The two genera may be characterized in the following terms:—

- A. The key-board of the stridulator placed upon the maxillary process of the coxa of the first pair of legs, the rasp or granular area in a slight depression on the adjacent surface of the coxa of the chela: the lower surface of the brachium with rows of piliferous pores and defined posteriorly by a ridge *Scorpio* (type *africanus*, L.).—*Distr.* Tropical Africa, S. Arabia.
- B. The key-board of the stridulator placed upon the coxa of the chela and the rasp upon the adjacent area of the coxa of the first pair of legs; the lower surface of the brachium without regularly arranged piliferous pores and posteriorly more convexly rounded *Palamnæus* (type *Petersii*, Th.).—*Distr.* Oriental Region (Bombay to Borneo).

I have noticed the position of the stridulator in the following species of *Scorpio*:—*africanus*, Linn.; *dictator*, Poc.; *cavimanus*, Poc.; *bellicosus*, L. Koch; *viatoris*, Poc.; *exitialis*, Poc.; and *Gregorii*, Poc.: and I think there can be no reasons for doubting that it will prove to be present in *Sc. africanus subtypicus*, Kraep.; *arabicus*, Kraep.; *pallidus*, Kraep.; and *meidensis*, Karsch; of which the last-named, I doubt not, belongs to the *exitialis*-like forms of the genus, and not to *Opisthophthalmus*, as Kraepelin has suggested.

As for Wood-Mason's organ, it occurs in specimens that I refer to the following species of *Palamnæus*:—*scaber* (Thor.); *Siammerdami* (Sim.); *fulvipes* (Koch); *megacephalus* (Koch); *casar* (Koch); *bengalensis* (Koch); *Phipsoni* (Poc.); *latimanus* (Poc.); *gravimanus* (Poc.); *indicus* (Linn.); *spinifer* (Hempr. & Ehrb.); *Thorellii*, Poc.; *liophysa*, Thor.; and *borneensis*, Thor.

It is also worth bearing in mind that the presence of these organs will serve as an additional character for separating *Scorpio* and *Palamnæus* from *Opisthophthalmus* and *Heterometrus*.

XI.—*The Bees of the Genus Andrena found in New Mexico.* By T. D. A. COCKERELL.

1. *Species with the abdomen partly or wholly rufous.*

a. Pubescence black.

Andrena prima, Casad, sp. n., ♀.

"Head, thorax, legs, and last abdominal segment black; segments 1 to 4 red; pubescence black; head as broad as thorax; clypeus, face, occiput, and cheeks sparsely hairy, clypeus and occiput punctate; face between antennæ striate longitudinally; antennæ black; mesothorax, scutellum, and postscutellum coarsely punctured, clothed with a few scattered black hairs; metathorax fringed, and pleura sparsely clothed, with black hairs; wings smoky from basal nervure to apex; tegulæ black, shiny; legs black, with black pubescence, that on anterior legs sparsely mixed with reddish-gold hairs; abdominal segments 1 to 4 reddish, bare, punctate and shiny, last segment black, fringed with black hairs; venter sparsely hairy. Length about 10 millim." (*Jessie E. Casad.*)

Hab. Little Mountain, Mesilla Valley, N. M., April 1, 1895, on *Krynitzkia*, believed to be *K. Jamesii* (*Casad*, 151). I took one on flowers of plum on the College Farm, March 30, 1896; this has the two last abdominal segments black, leaving only three red, but it is clearly the same species. The enclosure of the metathorax is wrinkled. This differs entirely from any described North-American species. The Mexican *A. modesta*, Sm., may resemble it somewhat from the description, but it is evidently a different thing.

b. Pubescence grey or fulvous.

a. Wings clear or only faintly clouded.

Andrena sphecodina, Casad & Ckll., sp. n.

"Black and red, pubescence ashy; head about as broad as thorax; clypeus, face, occiput, and cheeks clothed with pale hairs, clypeus punctured; face between antennæ and ocelli striated longitudinally; hair on pleura long; wings dusky hyaline, nervures brown, third submarginal cell very long, narrowed more than half toward marginal; tegulæ piceous, shiny; legs clothed with pale hairs, trochanter furnished with a tuft of long silky white hair, femora and basal portion of tibiæ black, tibiæ and tarsi red; first and second abdominal

segments with a small black spot laterally near base; first segment with sparse long hairs at sides, bare towards centre, without apical hairy band; hairy bands, interrupted on segments 3 and 4, on second reduced to a patch on each side; apical segments clothed sparsely. Length about 7 millim." (*Jessie E. Casad.*)

♀. Length 9 millim. Head and thorax black, abdomen entirely bright rufous, except the mostly black pygidium; a black patch on each side of first segment at base and a small black spot on each side of second segment. Legs black, the hind tibiae and tarsi light rufous. Clypeus with large close punctures, no median impunctate line. Mandibles scimitar-shaped. Antennae wholly black. Mesothorax microscopically reticulate, with excessively large punctures, becoming sparse in middle. Hind portion of mesothorax and scutellum shining, the latter with large punctures. Enclosure of metathorax longitudinally plicate, bounded behind by a salient rim. Abdomen with small sparse punctures. Anal fimbria fulvous.

♂. Like the female, but the antennae longer, the pubescence on clypeus paler and denser, the first segment of the abdomen black except its hind margin broadly, and the hind tibiae black.

Hab. Common about Las Cruces, N. M. Taken on *Sisymbrium* (10 males, one female) and on flowers of plum (3 males, two females) on the College Farm, April 9 and 12, 1895. One female on *Salix*, May 3.

This pretty species has the coloration of a *Sphcodes*; it could be confounded only with *A. Mariae*, Rob., and *A. Perezi*, Rob., = *erythrogastra*, Ashm., from both of which it is quite distinct by the coloration of the male &c.

A somewhat similar European species is *A. genevensis*, Schmied., but that has the end of the abdomen dark.

β. Wings strongly clouded apically.

i. Clypeus dark.

† First segment of abdomen very feebly and sparsely punctured.

Andrena Jessicæ, Ckll., sp. n.

♂. Length about 10 millim. Head and thorax black; abdomen rufous, with black markings, pubescence fulvous. Head slightly wider than thorax, face broad, orbits parallel; pubescence tolerably dense, concealing the surface, except on vertex; antennae black, the flagellum only tinged very dark brown on one side; mandibles black; clypeus strongly and

closely punctured; vertex dull, minutely rugulose, becoming striatulate, sparsely punctured. Thorax quite densely pubescent, except dorsulum and base of metathorax; mesothorax and scutellum microscopically tessellate, with rather large moderately sparse punctures. Enclosure of metathorax minutely granular, with irregular, small, rather obscure wrinkles, not bounded by a distinct rim. Tegulæ amber-colour. Wings yellowish hyaline, external margin broadly smoky, darkest towards the apex. Nervures and stigma reddish fulvous, costal nervure black. Third submarginal cell narrowed one half to marginal. Second submarginal much broader below than above. Legs black; anterior tibiæ partly in front, middle and hind tibiæ and all the tarsi ferruginous. Abdomen rather broad, shining, thinly pubescent, the pubescence forming thin bands along the apical margins of the second and following segments; first segment black, except hind margin and a central shade; second segment with a black spot on each side; fourth segment with a suffused black shade, fifth brownish black, as also the sixth, but the colour of that almost hidden by the pubescence. Venter rufous, the last three segments obscurely stained blackish. Surface of abdomen above microscopically tessellate, with the punctures very small and sparse.

Hab. College Farm, Mesilla Valley, N. M., April 9, 1895, on plum (*Jessie E. Casad*, 163). This is evidently near to *A. discreta*, Sm., from Oajaca, Mexico, of which only the female is known; it may possibly be its male, but there are several similar species, and Smith does not mention the abdominal punctuation.

†† First segment of abdomen strongly punctured.

Andrena argemonis, Ckll., sp. n.

♂. Length about 16 millim. Head and thorax black, abdomen black and rufous, femora black, tibiæ and tarsi ferruginous, pubescence fulvous. Head longer in proportion to its breadth, with the face narrower than in *Jessica*. Pubescence short, but quite dense on cheeks, occiput, sides of face, and between the antennæ. Clypeus medially bare except for a few scattered hairs, shining, with very close large punctures. Mandibles and antennæ wholly black. Vertex smooth and shining, with large, rather sparse punctures, which suddenly become smaller and very dense on front. Mesothorax and scutellum smooth and shining (not tessellate as in *Jessica*), with large, tolerably close punctures. Enclosure of metathorax granular, irregularly wrinkled so as

to be subcancellate, with a short raised rim behind, but not at sides. Pubescence of thorax quite orange-red, rather short but dense on sides of mesothorax, hind border of scutellum, postscutellum, pleura, and sides of metathorax. Tegulae shining reddish fulvous. Wings yellowish smoky, with a subviolaceous lustre, external margin broadly darker; nervures dark brown, costal nervure black, stigma small and narrow, ferruginous; third submarginal cell not narrowing half to marginal. Abdomen moderately shining, strongly and closely punctured, basal third of first segment smooth and practically impunctate. Pubescence foxy red, very short, forming bands on the hind margins of the segments, that on the first thin, the others dense and conspicuous. Colour of abdomen dark ferruginous, with an almost purplish tint; first segment black except its hind margin, third to fifth segments suffused with black, sixth dark brownish. Venter dark reddish, the last three segments becoming blackish.

Hab. Santa Fé, N. M., by the Denver and Rio Grande depot; two inside closed flowers of *Argemone platyceras*, on a dull afternoon, Aug. 3, 1895 (*Ckl.* 4150, 4151).

ii. Clypeus not dark, at least in the ♂.

† Dorsum of thorax honey-yellow.

Andrena mellea, Cresson.

Andrena mellea, Cresson, Trans. Am. Ent. Soc. 1863, p. 384, ♀.

†† Thorax entirely black.

(a) Pubescence of pleura, face, and cheeks fulvous; second segment of abdomen without a black band.

Andrena prunorum, Ckl., sp. n.

♂. Length about 12 millim. Head and thorax black, clypeus yellow, abdomen ferruginous and black, legs ferruginous, blackish at base, wings clouded at apex. Head broader than long, subtriangular or broadly subcordiform, whereas in *Jessica* it is more quadrate; fulvous pubescence quite dense all over face, cheeks, &c., only lacking on vertex, which is closely punctured. Clypeus large, closely but rather feebly punctured, light yellow, with two black dots. Basal process of labrum pitch-black, shining, emarginate, while in *Jessica* it is truncate, a little depressed medially, hardly emarginate. Mandibles wholly black. Antennae black, with the scape, funicle, first joint of flagellum, and base of second joint more or less strongly ferruginous.

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Thorax quite densely clothed with fulvous pubescence, as in *Jessica*; mesothorax and scutellum with close large punctures, the surface between the punctures smooth though rather dull, not tessellate as in *Jessica*. Metathorax closely pitted or subcancellate all over, with no defined enclosed space. Tegulæ shining amber-colour. Wings smoky hyaline, yellowish towards base, costa broadly suffused with fuliginous, the region of apex darkest; nervures ferruginous, the outermost fuscous, costal nervure black, stigma ferruginous. Third submarginal cell narrowing about half to marginal, but variable. Legs ferruginous, with short fulvous pubescence; trochanters black; femora largely suffused with black basally and beneath, middle femora incrassate. Abdomen fairly stout, strongly and closely punctured, with short fulvous pubescence clothing the whole dorsum, not obscuring the ground-colour, not forming distinct bands. First segment black, with the apical margin ferruginous; second segment ferruginous, with a large oval black mark at each extreme side; remaining segments black, with the hind margins broadly ferruginous. Venter ferruginous, with two black spots on third and broad black bands on fourth to sixth segments. Sometimes there is much less black on venter and the third segment above shows less black.

♀. Closely similar. Clypeus dull honey-yellow, with large punctures, smooth medially. Second joint of flagellum wholly ferruginous. Pubescence of thorax short and sparse, lateral margins of metathorax with a conspicuous fringe of whitish hairs. Tubercles slightly stained with ferruginous. Femora with scarcely any black. Trochanters partly ferruginous. A tuft of dull white hairs at base of hind legs. Hind tibiæ incrassate. First segment of abdomen only black at extreme base and at sides; second segment with very small lateral spots; third segment only narrowly black at extreme base. Anal fimbria shining coppery. Punctuation of abdomen finer than in the male. Segments 2 to 5 with distinct hair-bands.

Hab. Three specimens at Las Cruces, N. M., viz.:—(1) middle of April, 1894, collected by Miss Agnes Williams, a female; (2) on flowers of plum, College Farm, April 9, 1895, male; (3) on flowers of plum, March 26, 1896, male.

This shows much superficial resemblance to *Nomia nevadensis*, which is common at Las Cruces, but flies in August and September. *A. prunorum* is doubtless closely related to the Texan *A. malliventris*, Cr., but that has black legs and the antennæ are differently coloured, as also is the abdomen. It is also near to *A. fastuosa*, Sm., but differs in the colour of

the pubescence on the face and the colour of the legs, as well as in the pale clypeus.

A. prunorum, *Jessicæ*, and *Casadæ* all show a blunt curved tooth at end of hind coxa.

- (b) Pubescence of pleura, face, and cheeks dull white; second segment of abdomen with a black band.

Andrena Casadæ, Ckll., sp. n.

♂. Length about 10 millim. Head and thorax black; clypeus pale primrose-yellow, with two black spots; abdomen red and black; pubescence dull whitish, ochraceous on front, occiput, and dorsum of thorax; build more slender than in *prunorum*.

This is in all respects closely similar to *prunorum*, but differs in being smaller, the antennæ perhaps relatively somewhat longer, the base of the antennæ not ferruginous, the pubescence of the face relatively longer, the pubescence of the face, cheeks, pleura, and metathorax greyish white instead of fulvous, the basal process of the labrum not emarginate, the tegulæ dark brown, the mesothorax duller, the middle femora not so broad, the punctuation of the abdomen finer, the second abdominal segment black at base.

The flagellum is black, not fulvous beneath as in *modesta*. The scape shows only the slightest rufous stain in front. The mandibles are wholly black, bituberculate at base. The second segment of the abdomen is not entirely ferruginous as in *fastuosa*, which must, however, be closely similar.

Hab. College Farm, Mesilla Valley, N. M., April 9, 1895, on plum (*J. E. Casad*, 164).

2. *Species with the abdomen black or dark brown.*

a. Pubescence black.

Andrena nigerrima, Casad, sp. n.

♀. "Entirely deep shiny black, with black pubescence; head about as wide as thorax and but sparsely pubescent; clypeus large, punctured, shiny, but very slightly hairy; pubescence heaviest on sides of face and around insertion of antennæ; a longitudinal raised line between antennæ; flagellum becoming slightly brownish beneath and toward tip; face between ocelli and antennæ striated; occiput and cheeks punctured; mesothorax sparsely hairy, closely punctured; scutellum and pleura with dense tufts of long pubescence; metathorax comparatively bare, with fringed margins;

legs pubescent, that on edge of anterior tarsi and apical portion of tibiæ shiny golden brown; wings dusky hyaline, clouded beyond nervures, nervures and stigma piceous; tegulæ piceous, very shiny; abdomen bare save for scattered hairs laterally and fringe on last two segments; closely and finely punctured from apical half of first segment to apex, basal half of first segment very smooth and shiny. Length about 10 millim." (*Jessie E. Casad.*)

Hab. Mesilla, N. M., April 13, 1895, on lilac (*Casad*, 195). One on the College Farm, at flowers of plum, April 9, 1895 (*Ckll.* 2619).

In its general build and the black pubescence this closely resembles *A. prima*. The first joint of the flagellum is longer than the two following together; it is not so long as this in *prima*. The metathorax is minutely granular, with shallow punctures except on the enclosure, which is not bounded by a salient rim. In *prima* the enclosure is quite different, being strongly wrinkled. The wings are not so dark as in *prima*.

b. Pubescence grey, white, or fulvous.

a. Stigma ferruginous and apex of wings dusky.

Andrena fracta, Casad & Ckll., sp. n.

♂. "Black, head as wide as thorax, densely pubescent; clypeus yellow, circular, but thinly pubescent, with a black dot on each side halfway between upper and lower edges; a heavy fringe below clypeus, across lower edge of face; pubescence below antennæ and on cheeks pale, that above antennæ and on occiput ochraceous; thorax above clothed with ochraceous hairs, those on scutellum and postscutellum densest, those on metathorax and pleura pale. Legs black, femora and coxæ with pale hairs, those on tibiæ, tarsi, and apices of femora ochraceous; wings smoky hyaline, darkest beyond marginal cell and in second and third submarginals, in places stained with yellow; abdomen closely punctured, clothed with very fine short appressed hairs, which become ochraceous on fourth segment, and are sufficiently heavy on apical margins of segments 4 and 5 to form bands; apex quite heavily fringed with ochraceous. Length about 11 millim." (*Jessie E. Casad.*)

Small examples are only about $8\frac{1}{2}$ millim. long. The antennæ are quite long, wholly black.

♀. Larger and stouter; length about 12 millim. or slightly less. Black, the pubescence rather short, pale grey; ochra-

ceous on vertex, hind part of mesothorax, scutellum, and postscutellum, and on anterior and middle tibiæ and all the tarsi. Apex of hind femora with a conspicuous tuft of reddish-fulvous pubescence. Anal fimbria orange fulvous, very conspicuous. Head broader than long, vertex depressed; clypeus wholly black, shining, with large, not particularly close punctures, medially impunctate. Antennæ wholly black, first joint of flagellum longer than the two following joints together. Sides of face with broad white bands of appressed pubescence, partly hidden by the erect hairs immediately mesad of them. Vertex sparsely punctured. Basal process of labrum rounded, not emarginate. Lower corners of clypeus somewhat produced. Mandibles wholly dark, toothed within. Mesothorax quite closely punctured, scutellum not so closely. Enclosure of metathorax wrinkled-subcancellate, not bounded by a distinct rim. Tegulæ piceous. Wings strongly yellowish except at lower outer part, which is hyaline; apex strongly smoky, the dark colour extending a little into the marginal cell. A smoky cloud also in and about second submarginal. Nervures dark brown, stigma ferruginous. Third submarginal narrowed about one half to marginal. Hind wings slightly smoky at apex. Abdomen strongly and closely punctured, segments 2 to 4 with conspicuous even bands of white pubescence, that on 2 weak in the middle.

Hab. Three males and three females, all on flowers of plum, College Farm, Mesilla Valley, N. M., April 10, 1895 (*Casad*), and March 26, 1896 (*Ckll.*).

Near to *A. nubecula*, Sm., but differs by the colour of the antennæ and tegulæ. *A. reflexa*, Cr., also seems to be allied*.

* The following species, belonging to this section but at once distinguished from *fracta* by the clypeus being yellow in the female (as in *Alicie*, Rob.), may be expected to occur in New Mexico:—

Andrena mexicanorum, Ckll., sp. n.

♀. Length about 11 millim., fairly stout, black, with a broad band across the face; tubercles (with a black dot) and spot on tegulæ pale primrose-yellow. Pubescence very sparse, greyish, with a very slight ochraceous tinge. Head subquadrate, broader than long; upper half of clypeus just enclosing the black dots, bulging downwards medially; a broad supraclypeal area, dog-ear marks, and subquadrate lateral marks pale primrose-yellow, the whole forming a broad band, the upper margin of which is straight. Face very sparsely hairy, even the cheeks with hardly any hairs. Basal process of labrum truncate. Mandibles wholly dark. Antennæ very short, wholly dark. Clypeus with very large rather sparse punctures, the upper median portion impunctate. Vertex with large tolerably close punctures. Mesothorax and scutellum smooth and

β. Stigma dark brown or black; apex of wings dusky.

Andrena asclepiadis, Ckll., sp. n.

♂. Length 10–12 millim. Rather slender, with the abdomen long and subcylindrical. Black, shining, face below level of antennæ primrose-yellow; two black spots on clypeus; tubercles yellow, with two black dots; tegulæ with a yellow spot. Head rounded, somewhat broader than long; face hardly pubescent, occiput and cheeks with pale greyish hairs; lower margin of clypeus black, mandibles wholly black, pale supraclypeal area much more nearly square than in *mexicanorum*; antennæ short, wholly black, first joint of flagellum not quite so long as second and third together. Clypeus with large sparse punctures, vertex strongly punctured. Thorax with the pubescence short, pale grey, and very sparse, but enclosure of metathorax pubescent. Mesothorax and scutellum smooth and shining, with large, not particularly close, punctures. Tegulæ clear testaceous, with a light yellow mark; wings hyaline, tinged with ferruginous, outer margin, especially apically, smoky. Nervures brown; costal nervure black, stigma very dark brown. Marginal cell truncate, appendiculate. Anterior tibiæ mostly whitish in front, middle tibiæ with a white patch at base; tarsi ferruginous, last four joints of hind tarsi black. Outer margin of hind tibiæ strongly crenulated or subserrate. Claws deeply cleft. Abdomen strongly punctured, segments with narrow basal white hair-bands.

Hab. Santa Fé, N. M., on white *Asclepias*-flowers, Aug. 1, 1895 (*Ckll.* 4033). Also one at Albuquerque, N. M., between the town and the University, June 30, 1895 (*Ckll.* 3263). One at La Junta, Colorado, on a white-flowered *Asclepiad*, July 1895 (*Ckll.* 3648). The La Junta example is larger than that from Sta. Fé, and has the wings more

shining, with large not particularly close punctures. Enclosure of metathorax ill-defined, pubescent, quite densely at sides. Tegulæ testaceous, with a large yellow spot. Wings hyaline, quite strongly tinged with ferruginous; apical region with a conspicuous smoky cloud. Nervures brown, costal nervure black, stigma ferruginous. Marginal cell truncate, appendiculate, second recurrent nervure slightly curved, but not as in *Colletes*. Legs black; a yellow spot at base of four anterior tibiæ; no tuft of hair on hind trochanters; claws ferruginous. Abdomen strongly punctured, with narrow dull white hair-bands at bases of segments 2 to 4. Anal fimbria dull brownish.

Hab. Juarez, Mexico, Aug. 26, 1893 (*Ckll.* 493 a).

Has some superficial resemblance to *Colletes inaequalis*, Say. It is nearest to *A. asclepiadis*.

dusky, hardly at all ferruginous, the stigma black. The teeth on the hind tibiae are better developed, about twenty in number.

Although *mexicanorum* falls in the same artificial section as *fracta*, it really has nothing to do with that insect, but is very closely related to *asclepiadis*. I was at first inclined to regard these allied forms as sexes of one species, but they come from different localities and the clear ferruginous stigma of *mexicanorum* is distinctive. Yet I suppose they are rather geographical races than distinct species, and intermediates may be looked for in the Rio Grande Valley between Juarez and Albuquerque.

These two bees are not true *Andrena*, but will fall in a new group (genus or subgenus) distinguished by the truncate marginal cell, crenate-dentate hind tibiae of male, pubescent enclosure of metathorax, narrow elongate male abdomen, short antennae in both sexes, and the considerable amount of yellow on face even in female. The maxillary palpi are six-jointed, the glossa pointed at tip. I have also three smaller species, which are congeneric but do not have the wings conspicuously clouded at the apex.

γ. Wings not conspicuously clouded at apex.

i. Head very large; hind margins of cheeks strongly keeled.

Andrena platyparia, Rob., race *occidentalis*, Ckll., n. race.

♂. Length about 9 millim. Differs from *platyparia* by the flagellum being wholly black, the legs very dark brown, so as to seem black except the paler tarsi, the abdomen piceous, margins of the segments narrowly testaceous. The first joint of the flagellum is not so long as the second and third together. Clypeal punctures sparse but distinct. Basal process of labrum projecting, rounded. Mandibles toothed within. Front conspicuously longitudinally striate. Vertex microscopically tessellate. Cheeks with a very strong keel behind, curving over to the apex of the orbits. Pubescence throughout dirty whitish, thin but quite long, slightly tinged with ochraceous on dorsum. Mesothorax dullish, microscopically tessellate, with shallow sparse punctures; scutellum much more shining, with only a few scattered punctures. Enclosure of metathorax ill-defined, dull and granular, with a row of short wrinkles along base. Tegulae dark testaceous. Wings smoky hyaline, tinged brownish; nervures and stigma brown. Abdomen microscopically tessellate, with hardly

observable small scattered punctures. Thin hair-bands on segments 5 and 6.

Hab. Monument Rock, Santa Fé Cañon, N. M., Aug. 11, 1895, 8000 feet (*Arthur Boyle*).

A very peculiar insect, so nearly agreeing with the description of *A. platyparia* that I can only consider it a geographical race. *A. fragilis*, Sm., may possibly be allied, but Smith's description is very short.

ii. Head normal.

- (a) Pubescence of thorax bright fulvous; a large yellow mark on each side of face; stigma very small.

Andrena pulchella, Rob.

Two females on flowers of *Helianthus annuus* at Las Cruces, N. M., Sept. 22 and Oct. 6, 1895. The clypeus and legs are darker than in the typical form found in Illinois.

- (b) Rather small species; clypeus yellow in the ♂; abdomen with two orange bands.

Andrena aureocincta, Ckll., sp. n.

♂. Length about 9 millim. Black, with the clypeus yellow and the abdomen with orange bands. Pubescence pale ochraceous, thin, but rather long. Head broader than long; clypeus high, primrose-yellow, with two black spots, with large sparse punctures, almost impunctate in middle, its lower margin piceous, projecting. Basal process of labrum roundly emarginate. Mandibles simple, black, with the extreme tips rufous. Pubescence of face and cheeks rather long, but not dense enough to hide the surface. Front dull, minutely aciculate sculptured; vertex irregularly punctured, bare just laterad of the ocelli. Antennæ long, reaching as far as postscutellum, wholly black, scape hairy, first joint of flagellum not quite so long as second and third combined. Mesothorax dull, strongly and rather closely punctured. Enclosure of metathorax without a raised rim, minutely transversely wrinkled. Tegulae shining piceous. Wings smoky hyaline, the apical region slightly darker; nervures and stigma dark ferruginous brown, costal nervure black. Second submarginal cell almost exactly square. Legs black, all the tarsi orange-brown; hind tibiae orange-brown, with a suffused black blotch on each side. Hind coxæ with a curved tooth. Abdomen strongly and closely punctured, brown-black, with orange bands occupying the hind margin of first

and extreme base of second segments, and again the adjacent parts of the second and third; the hind margins of segments 3 and 4 also narrowly orange, just before the hair-bands. Continuous fulvous or ochraceous hair-bands at the apical margins of all the segments. Venter orange on second and part of third segments.

Hab. Santa Fé, N. M. (*Myrtle Boyle*). Taken in 1895, almost certainly in July or August. Not much like anything known to me.

(c) Fairly large species; clypeus dark in the ♂; pubescence grey or slightly ochreous.

† Abdomen with hair-bands, more or less developed even in the ♂; stigma dark brown.

Andrena electrica, Casad & Ckll., sp. n.

♂. Length 10 to 11 millim. Entirely black, the terminal joints of the tarsi only becoming brownish; pubescence copious and long on head and thorax, silky, greyish white, shining white on clypeus, pleura, and occiput, as also on cheeks, where it is very long and erect. Antennæ long, wholly brown-black, first joint of flagellum not nearly so long as second and third together. Head subquadrate, considerably broader than long. Mandibles wholly dark, toothed within. Basal process of labrum emarginate. Clypeus hidden by the hairs; front and vertex bare, front dull, minutely striatulate; vertex minutely roughened, with a few punctures near the top of the eyes, a small smooth space immediately laterad of the lateral ocelli. Punctures of mesothorax and scutellum rather sparse; enclosure of metathorax dull, ill-defined, with no raised margin, not wrinkled. Tegulæ brown. Wings clear hyaline; nervures and stigma brown; second submarginal cell quite broad. Abdomen moderately shining, microscopically tessellate, with very minute sparse punctures. First segment and sides of second with fairly abundant erect hairs, not concealing the surface; the remaining segments with scattered short pale hairs, looking like fine dust, dense enough on the apical margins to give the appearance of narrow, more or less interrupted, ill-defined bands. Margins of ventral segments with well-defined white hair-bands.

♀. Larger and stouter, 11 to 12 millim. long. Pubescence tinged with greyish ochreous, especially on dorsum of thorax, nowhere really white, except on hind femora and the floccus on hind trochanters. Pubescence of face shorter and more sparse, permitting the clypeus to be seen. Clypeus

minutely sculptured and with large rather close punctures; no median impunctate area. Basal process of labrum broadly triangular. Hairs fringing labrum and on lower part of clypeus dark brown, with a reddish tint. Antennæ short; first joint of flagellum as long as the two next together, tip of flagellum becoming reddish brown. Sides of face with broad pale greyish-ochreous bands of appressed pubescence. Tegulae piceous. Wings with the outer margin broadly tinged dusky. Stigma darker than in male. Abdomen with four very distinct pale grey hair-bands, all continuous. Anal fimbria dark grey-brown, with rather a chocolate or purplish tinge. The clypeus may have a narrow median impunctate line.

Hab. College Farm, Mesilla Valley, N. M., on flowers of plum, April 9, 1895 (one male, one female); April 10, 1895 (one female); March 25, 1896 (one female); March 26, 1896 (one male). Also on *Sisymbrium*, April 12, 1895 (one male), and April 16 (one female).

Miss Casad had described the two sexes as distinct species, and I should myself have treated them as such but for the circumstances of their capture. They do not differ, however, as much as the sexes of *A. vicina*, though in a different way. *A. placida*, Sm., must be a similar species, but the abdominal bands in the female are not entire. The description of *A. verecunda*, Cr., almost exactly applies, but that has the anal fimbria cinereous, whereas the dark anal fimbria is perhaps the most noticeable feature of *electrica*.

†† Abdomen without hair-bands; stigma ferruginous.

Andrena mesillæ, Ckll., sp. n.

♂. Length about 11 millim. Quite stout, with the abdomen oval, convex, shining; black, the pubescence silky, greyish white, very copious on head and thorax, practically wanting on abdomen, except on first and second segments, which are delicately pruinose-pubescent, the pubescence dense enough at the sides to be rather conspicuous. Head rather large, a little broader than long. Clypeus concealed by dense white pubescence; front mostly bare, striatulate; vertex with rather sparse punctures. Cheeks swollen behind. Antennæ rather long, dark chocolate-brown; first joint of flagellum very short, no longer than second. Mandibles entirely dark. Thorax densely pubescent, the pubescence of the same colour throughout, nowhere at all ochraceous; enclosure of metathorax bare, with no raised rim, dull, minutely

transversely lineolately sculptured, basally longitudinally wrinkled. Tegulæ shining piceous. Wings hyaline, with a very faint yellowish tinge, outer margin broadly tinged smoky; nervures and stigma pale ferruginous, costal nervure black. Second submarginal cell broad, little narrowed above, receiving the first recurrent nervure at its middle. Marginal cell blunt at tip, minutely appendiculate. Legs black; femora with long but thin white pubescence; hairs of inner surface of tarsi shining rufous. Claws rufescent. Abdomen coal-black, with fairly close, very small punctures; apex with fuscous hairs.

Hab. College Farm, Mesilla Valley, N. M., on flowers of plum, March 26, 1896.

This insect at once reminds one of the male of *A. vicina*, Sm. (*hirticeps*, Sm.), but it differs in being a little larger, in the colour of the pubescence, the sculpture of the meta-thorax, &c.

(d) Small species.

It is proposed to discuss these, as also a species with a blue abdomen (*A. cerasifolii*, sp. n.), in a separate article.

The types of all the new species described will be placed in the U.S. National Museum; it is hoped to send co-types to the British Museum and Coll. Amer. Entom. Society.

Las Cruces, New Mexico, U.S.A.,
April 30, 1896.

POSTSCRIPT.

PROTANDRENA, gen. nov.

Since writing the account of the New Mexico species of *Andrena* I have become acquainted with three other species congeneric with *A. asclepiadis* and *A. mexicanorum*; and a renewed study convinces me that I have to do with a perfectly valid new genus, which I will call *Protandrena*. Mr. Fox, of Philadelphia, to whom I sent two of the species, also agrees that the genus is quite distinct from *Andrena*. In addition to the characters I have cited when describing the species, I may add the following, based on an examination of *P. maurula*:—

Tongue short and broad, gradually coming to a point, narrower at end than in *Andrena*, but not nearly so narrow as in *Halictus* (see figures given by Mr. E. Saunders, Journ.

Linn. Soc., Zool. xxiii. pls. iii., iv.). Labial palpi 4-jointed, first joint at least as long as the other three together, 3 shortest, 2 hardly longer, 4 narrow and very little longer than 2. Maxillary palpi 6-jointed; the joints subequal, 5 shortest.

The known species may be separated thus:—

A. Large species:

- (1) Stigma ferruginous *P. mexicanorum*, Ckll. (Mexico.)
 (2) Stigma dark *P. asclepiadis*, Ckll. (New Mexico,
 Colorado; also Fedor, Texas, as I
 learn from Mr. Fox.)

B. Small species:

- (1) Tarsi piceous in ♀ *P. trifoliata*, Ckll. (New Mexico.)
P. maurula, Ckll. (Texas.)
 (2) Tarsi rufous in ♀, yellowish white in ♂ *P. heteromorpha*, Ckll. (New Mexico.)

It is not worth while to give the full distinguishing characters here, as they are given in connexion with the detailed descriptions.

Mesilla, New Mexico, U.S.A.,
 June 2, 1896.

XII.—*Description of a new Species of the Leaf-footed Centipede (Alipes) from Nyasaland, together with Notes upon the previously described Species of the Genus.* By R. I. POCKOCK.

THE generic synonymy of this interesting centipede, as first pointed out, I believe, by Kohlrausch (Arch. Nat. 1881, pp. 76–77), is as follows:—

ALIPES, Imhoff, Verh. naturforschenden Ges. Basel, i. p. 120, pl. i., Sept. 4th, 1854. (Type *multicostis*, Imh.)

EUCORYBAS, Gerstaecker, Stettin. ent. Zeitsch. xv. p. 309, pl. ii. fig. 1, Oct. 1854. (Type *crotalus*, Gerst.)

The three species of the genus that have been hitherto established appear to me to be readily recognizable forms, though most authors seem willing to admit only two of them. To these three a fourth has here been added.

Alipes multicostis, Imhoff.

Alipes multicostis, Imhoff, *op. cit.* p. 120, pl. i.

This species was originally recorded from the Gold Coast, on the Gulf of Guinea, and specimens of presumably the

same species have since been acquired from Sierra Leone and the Cameroons (*vide* Porat, Bih. Sv. Vet.-Akad. Handl. xx. pt. ii. no. 5, p. 15, 1895). The British Museum has examples from Cape Palmas (*Alvan Millson*) and the Cameroons (*Johnston*) which, without much doubt, are also to be referred to this species.

The specimens from the Cameroons are in a good state of preservation. The largest measures 120 millim. in length and 7·5 in width, the anal leg being 36 long, or as long as the last six segments and part of the seventh; the head and first three segments are a deep blackish green, while the rest are reddish brown with a green stripe along the hinder border, and the legs are a bright ochre-yellow, except the anterior three pairs, which are tinted with green. The second specimen, measuring 78 millim. long and 4·8 wide, with the anal leg 28, resembles the large one in a general way as regards colour, except that the anterior half of the body is greener and there is no transverse stripe on the posterior border of the posterior tergites. Again, the crests and spicules on the tergites are stronger than in the large individual, a fact which seems to show that these structures wear down with age. So, too, the grooves and spicules on the legs become less pronounced with increase of size. The two specimens from Cape Palmas are of smaller size (62 millim.) and are of a uniform deep green colour. In these, again, the sculpturing is coarse, but unfortunately they have no anal leg.

This species may be distinguished by the form of the anal legs; the expansions of the tibiae are of very large size, both rise from the anterior end of the segment, and though the lower has a more convex margin, it is not larger at its distal end; the distance between these points is nearly equal to the length of the segment along the middle line; the height of the protarsus is about five sixths of its median length, or, in the small specimen, rather less, while the height of the tarsus is about four fifths of its length (fig. *a*, p. 96).

Alipes crotalus (Gerst.).

Eucorybas crotalus, Gerstaecker, *op. cit.* p. 309, pl. ii. fig. 1.

Recorded originally from Natal, whence the British Museum has received three examples collected by Gueinzius, one by Mr. Plant, and one by Colonel Bowker. All these examples agree closely with Gerstaecker's figure and description, and are no doubt co-specific with his specimen. Fortunately all of them are provided with the anal legs, so that it becomes possible to test the constancy of the features

presented by these organs. The length of the largest specimen is 64 millim. and the width 5, and in an example preserved in alcohol, measuring 61 millim., the width is just under 5. The width is thus more than one thirteenth of the length, whereas in the examples of *multicostis* mentioned above the width is about one sixteenth of the length, so that, even making due allowance for variation in this respect owing to longitudinal shrinkage, it may be said that on the whole *crotalus* is stouter than *multicostis*. A further distinction seems to be found in the sculpturing of the terga, the sutural crests being much stronger as compared with the one in the middle line in *crotalus*. The colour, too, of the specimens of *crotalus* is less green, being rather of a deep pinkish brown. I do not, however, find that the features mentioned by Lucas to distinguish *Grandidieri* from *crotalus* hold good. The impressions or spots on the first tergite, for example, are scarcely distinguishable, and the excavation of the inner surface of the patella of the anal leg is attributable to drying. In one example, for instance, the excavation is present on one leg but not on the other. It is, however, by the anal leg, which sometimes exceeds the length of the posterior seven body-segments, that *crotalus* may be most readily distinguished from *multicostis*. In the former the two expansions of the tibia are smaller and rise further back, but the distance between the terminal points is nearly equal to the median length of the segments. The protarsal and tarsal laminae are, on the other hand, larger than in *multicostis*, the tarsus being nearly as high as it is long. The latter is often armed at the tip with a minute claw (fig. *b*, p. 96).

Alipes Grandidieri (Luc.).

Eucorybas Grandidieri, Lucas, Ann. Soc. Ent. Fr. (4) iv. p. 420 (1864);
id. *op. cit.* (5) i. pp. 448-451, pl. vii. figs. 1-7 (1871).

This species, recorded originally from Zanzibar, appears to me to be quite distinct, as Lucas surmised and other authors seemingly admit, from the Natal form *crotalus* of Gerstaecker. Apart from the other differential characters pointed out by Lucas, the relatively small size of the laminate expansions on the anal legs are sufficiently diagnostic. So, too, does it seem to me, in spite of the contrary opinion advocated by both Gerstaecker (Von der Decken's 'Reisen in Ost-Afrika,' iii. 2, p. 524) and von Porat (Bih. Sv. Vet.-Akad. Handl. xx. pt. ii. no. 5, p. 15), that *Grandidieri* must also be regarded as distinct from the West-African species *multicostis*, Imhoff, the figure of which, judging from specimens in the British

Museum, is very fairly accurate, and from which it appears that the laminate expansions of the anal tibia are larger even than in *crotalus*, so that the height of this segment at its distal end measured from angle to angle is nearly equal to its median length. Lucas, moreover, describes his specimen as having the dorsal surface very obsoletely granulate; but the value of this statement depends upon whether or not the describer was personally acquainted with the granulation of other species of the genus.

Alipes appendiculatus, sp. n.

Colour a dull olive-green, antennæ and legs yellow; head tinted with ochre.

Head a little wider than long ($5:4\frac{1}{2}$), semielliptical, sparsely punctured, and weakly bi-impressed.

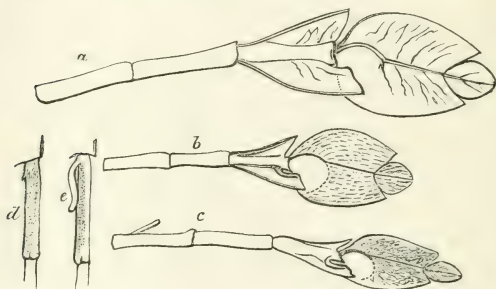
Antennæ moderately long, composed of 17 or 18 segments, whereof the basal three are naked and the rest pubescent; the apical not longer than the penultimate.

Maxillipedes also sparsely punctured; coxal plate marked in front with a median abbreviated sulcus and two obliquely transverse lateral sulci; precoxal plates of medium size, separated, each armed with 4 conical teeth; femoral tooth strong.

Terga.—First and second smooth or spicular, sparsely punctured; third to twenty-first covered with spicules, which increase in quantity towards the hinder end of the body, also carinate, the anterior ones less strongly than the middle and posterior, though on the fifth the seven longitudinal crests are distinctly visible, the crests placed as follows:—one median, two sutural (one for each longitudinal sulcus), two marginal—that is, the normal marginal elevation,—and two, one on each side between the marginal and sutural, of irregular shape and formed by a fusion of tubercles; on the fifth, seventh, eighth, tenth, twelfth, fourteenth, sixteenth, and eighteenth, but indistinct on the anterior and posterior of these, there is an oblique crest on each side passing anteriorly from the marginal to the sutural; in the middle and posterior part of the body the marginal crest is notched, so as to be almost bitubercular at its hinder end; the sutural crests increase in strength towards the hinder end, terminating on the twentieth segment in an upstanding tubercle; the median crest only a little narrower and lower than the sutural crests in the middle of the body; the lateral crests become gradually obsolete posteriorly and are scarcely visible on the twentieth.

Sterna smooth, sparsely punctured, marked with three obsolete impressions, two lateral and one posterior median.

Anal somite.—*Tergite* with strongly raised margins, not otherwise crested, but thickly granular; *pleuræ* densely porous throughout, produced into a blunt unarmed process; *legs* about as long as the last seven body-segments; the femur and patella cylindrical, about four or five times as long as thick, densely spicular, especially the femur on its inner surface at the base, the patella nearly smooth posteriorly; the inner side of the femur at the base armed in one specimen (♀?) with a short spiniform tubercle, in the other (♂?) with a long, cylindrical, smooth process, which curves backwards and extends just beyond the middle of the segment; the



- a. Anal leg of *Alipes multicostis*, $\times 2$.
 b. Anal leg of *Alipes crotalus*, $\times 2$.
 c. Anal leg of *Alipes appendiculatus*, $\times 2$.
 d. Femur of anal leg of *Alipes appendiculatus* (♀, $\times 2\frac{1}{2}$.
 e. " " " " (♂), $\times 2\frac{1}{2}$.

upper plate of the tibia rising in the middle of the segment, but small, ending in an acutely angular prominence, which is less than half the size of the extremity of the inferior plate; the latter rises at the base of the segment and ends in a three-sided process overlapping the base of the succeeding segment; the total height of the tibia at its posterior extremity is a little greater than half the length of the segment; first tarsal (protarsal) segment not quite twice as long as high, with evenly convex upper and lower edges; the median thickening of the segment lightly curved and thicker in its basal third; the surface of the segment distinctly roughened with tubercles; the tarsus without trace of claw, its height two thirds of its length, its posterior width about four fifths the length of the tarsus; tarsus an elongate oval, its height less than two thirds of its length, no claw (figs. c, d, e).

Legs finely spicular above and laterally, like the terga, but less thickly, the posterior more so than the anterior; the upperside of the patella and tibia longitudinally grooved; a tarsal spur on the anterior eight (or fewer) pairs, also an anterior tarsal spur, on the anterior four pairs an anterior tibial spur, and on the first pair an anterior patellar spur.

Length (♀) 95 millim., width 6·5, length of anal leg 30, height of protarsus 4·5; length (♂) 85, width 5·5, length of anal leg 28·5, height of protarsus 4.

Loc. Zomba, 3000–9000 feet (types), Milangi, both in Nyasaland (*Sir H. H. Johnston*).

Three examples were obtained at Zomba and one at Milangi; the smallest of those from Zomba, measuring 71 millim. in length, has lost its anal legs, but it is noticeable that the sculpturing of the terga is coarser, the spicules appearing on the first tergite, whereas in the largest specimen they do not set in until the third; there is, moreover, a distinct median crest on the last tergite, of which the largest specimen shows no trace. The Milangi example has also lost these appendages, but it agrees with the type in other respects; its length is 83 millim.

This species seems to differ from all the previously described forms in the fact that its anal legs are furnished either with a long process or with a spiniform tubercle in its place; none of the other specimens of the genus in the British Museum show a trace of these structures, and no mention of such appears to have been made in literature. Apart from this, the anal legs seem to closely resemble those of *A. Grandidieri*, the type of which, judging by the length, 56 millim. (possibly including the anal legs), was not full-grown. It is necessary, therefore, to bear in mind the possibility of *A. appendiculatus* proving to be the adult of *A. Grandidieri*—a conclusion rendered to my mind still more probable by the fact that a specimen of this genus in the British Museum from Mombasa, which on geographical grounds might be expected to be the same as *Grandidieri*, does not present any features by which it may be separated from *appendiculatus*; but, unfortunately, its anal legs are gone, so that the organs that offer the best specific features cannot be compared. The length of this specimen is 68 millim., and its head is as long as wide, so that in these respects it comes between *Grandidieri* and *appendiculatus*.

In the absence of an armature of spines from the lower surface of the anal femora, as well as in the bluntly ended unarmed anal pleuræ, the genus *Alipes* resembles the genus *Parotostigmus*, Poc. (Biol. Centr.-Amer., Chilopoda, p. 25,

Jan. 1896). It is, further, interesting to note that this new species in its remarkable sexual character approaches the South-American *Parotostigmus scabricauda* (Humb. & Sauss.).

Synopsis of the known Species of the Genus.

- a. Femur of the anal leg with a tuberculiform spine (? ♀) or a long curved process at its base on the inner side (? ♂); the plates upon distal segments relatively small, apparently very much as in *Grandidieri* *appendiculatus*, sp. n. (Nyasaland.)
- b. Femur of anal leg armed neither with a spine nor a process.
 - a¹. Crests on the tibia of anal leg small, their height from point to point equal to only about half the median length of the segment; height of protarsus similarly much less than its median length; tergal plates very obsoletely granular (*teste* Lucas) *Grandidieri*, Lucas. (Zanzibar.)
 - b¹. Crests on the tibia of anal leg much larger; height of segment from angle to angle nearly equal to its median length; protarsus also nearly as high as long (at least in the adult); tergal plates thickly studded with spicules.
 - a². Stouter form, the sutural crests on the terga very much larger than the median; tibial expansions of the anal leg smaller as compared with those of the protarsus, so that the height of the former is only about two-thirds the height of the latter. *crotalus*, Gerst. (Natal.)
 - b². Slenderer form, the median tergal crest not very much smaller than the sutural crests; tibial expansion of anal leg relatively larger and the protarsal smaller, the height of the former being about five-sixths that of the latter *multicostis*, Imhoff. (Gold Coast, Cameroons.)

In addition to the specimens mentioned above the British Museum has others which, having lost their anal legs, as so often happens, it is not possible to identify. Two of these from Kinyamholo, Lake Tanganyika (*W. H. Nutt*), are of great interest on account of the weakness of the wrinkles, crests, and spicules on the terga. It is only in the posterior half of the body, in fact, that this sculpturing is at all strong. These specimens are the only ones seen by me which, as compared with the rest of the genus, fall in with Lucas's definition "très-obsoletement granulée." It is, of course, very possible

that they will prove to be referable to *Grandidieri*. There is also the unidentifiable specimen from Mombasa referred to above and one from South Africa (? West Africa), probably belonging to *multicostis*, obtained by Capt. Burton.

From considerations of geographical distribution I should be inclined to think that the specimen from Caffraria, described by Porat as *Grandidieri*, will prove to belong to *crotalus* (Æfv. Vet.-Akad. Förhandl. 1871, p. 1162).

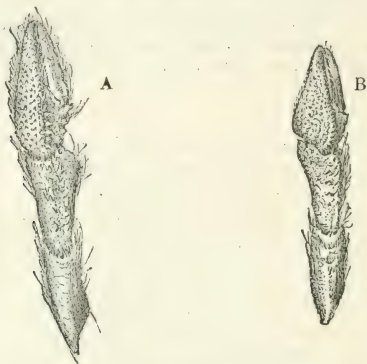
XIII.—*A Question concerning a British Pagurid.* By JAMES E. BENEDICT, Assistant Curator, Department of Marine Invertebrates, U.S. National Museum.

BRITISH naturalists have not recognized *Pagurus Kröyeri**, Stimpson, as a valid species. They refer it to *P. pubescens*, Kröyer, or, as Mr. Henderson has done, call it *pubescens*, var. *Kröyeri*. On this side of the Atlantic the species is recognized as distinct from *pubescens*. *P. Kröyeri* and *P. pubescens* are quickly and accurately separated not by the pubescence, abundant on the one and comparatively inconspicuous on the other species, but by the marked difference in the form of the left hand, as the most obvious character (see figs A and B, p. 100). The idea that British naturalists cannot as readily see these characters with both species before them is not to be entertained. We must look further for the explanation. Prof. S. I. Smith says †:—"Kröyer's figure in Gaimard's 'Voyages en Scandinavie,' Crustacés, pl. ii. fig. 1, evidently represents the *Kröyeri*, although the tubercles upon the chelipeds are represented in the figures as a little too large and more scattered than in any specimens I have seen; but this is probably due to a slight and very natural inaccuracy on the part of the artist or engraver; the original description of *Pagurus pubescens* ('Naturhistorisk Tidsskrift,' ii. p. 251, 1839), however, applies best to the other species, which Kröyer evidently had before him when writing the first phrase of the diagnosis—"cephalothoracis superficie dorsali pedibusque pilis flavis dense obsitis"—which would not apply to any specimens of *Kröyeri* or to his figure published ten years after. Kröyer

* It seems necessary to change the name of the group of which *Bernhardus* is the type to *Pagurus*. I believe that the genus *Pagurus*, as now constituted, does not contain a single one of the original species placed in it by Fabricius; but, be that as it may, a valid and therefore imperative reason for making the change lies in the fact that *Bernhardus* was designated as the type of *Pagurus* by Latreille in 1810 (Consid. Génér. Crust. p. 421).

† Trans. Conn. Acad. v. p. 49.

mentions having numerous specimens from different places on the Greenland coast and from Iceland, and it is probable, as Stimpson suggests, that he failed to distinguish the two species, as nearly all carcinologists have done since."



A. Left cheliped of *Pagurus pubescens*.

B. Left cheliped of *Pagurus Kröyeri*.

An examination of the specimens from European localities in the National Museum and in the Peabody Museum at New Haven does not disclose a single specimen of *pubescens*, though they are all so labelled. May we not look for the explanation of the matter here? *P. pubescens* may not occur in European waters. If only *Kröyeri* is found there, and it is identical with Bell's *Thompsoni*, then the name *Thompsoni* will have to be applied to the so-called *pubescens* of European waters and to the *Kröyeri* of American waters. It is to be hoped that European collections will be re-examined and the result made known. In the meantime we shall not expect British naturalists to recognize two species by separating specimens with little hair from those having less, or to accuse naturalists on this side of the water of having done this in the past.

XIV.—*Descriptions of new Species of Nanina, Helix, Amphidromus, and Porphyrobaphe.* By HUGH FULTON.

Nanina (Oxytes) fidelis, sp. n.

Shell depressed, deeply and rather widely umbilicated, sculptured all over with oblique, close-set, somewhat granular

striæ, acutely keeled, last half-whorl with fine spiral decussated striæ above; whorls 5, slightly convex, last compressed at outer margin; aperture very oblique; peristome somewhat thickened and slightly pressed outwards at basal margin, but not reflected; ground-colour fulvous brown, interior of aperture whitish; extremities of peristome connected by a thin callus.

Height 13 millim., maj. diam. 32 millim.

Type in British Museum.

Loc. Khasi Hills, N.E. India.

This form comes between *oxytes* and *cycloplax* of Benson. In form it is like the former, but is smaller, of a darker colour, and easily separated by its granular sculpture. It is flatter and much more sharply keeled than *cycloplax*, and has the granular striæ all over the shell, whereas *cycloplax* is almost smooth on the underside.

Helix (Xenothauma) Baroni, sp. n.

Shell depressly orbicular; umbilicus deep, about 6 millim. wide, funnel-shaped, keeled at the margin and finely concentrically lirate within; colour dirty white, with 5 or 6 raised and somewhat granular spiral liræ on each whorl, between which are fine spiral striæ; the underside has the same sculpture as above, but the lines of growth are rather more strongly developed than on the upper part; whorls $4\frac{1}{2}$, almost flat, the last whorl compressed at outer margin and very acutely keeled, sharply deflected anteriorly, descending to just below the edge of the umbilicus; nucleus prominent, consisting of $2\frac{1}{2}$ whorls, distinctly separated from the rest and sculptured with close-set, microscopic, oblique striæ, decussated with fine spiral lines; peristome continuous, quite free, of an irregular triangular form, the compressed keel forming a narrow channel within, thin, broadly expanded, partly concealing the umbilicus; margins white; interior of aperture of a light brownish colour.

Height 12 millim., maj. diam. 30 millim.

Type in British Museum.

Loc. Rio Yonan, Peru, 4000 feet (*C. T. Baron*).

This remarkable form, were it not for its entirely different nucleus, would fit well into the Madeiran group of *Geomitra*, its general resemblance to *G. delphinula*, Lowe, being very close. There does not appear to be any known species from South America which bears any resemblance to this species, which has more the appearance of certain European and North-African species, such as *H. Gualteriana*, Linn., *H. violæ*,

Ponsonby, and *H. sultana*, Morelet. Knowing of no subgenus to which I can relegate this species, I propose to institute for it the genus or subgenus *Xenothauma*; the apical character of *X. Baroni* separates it from all other South-American Helicidæ. In Pilsbry's excellent arrangement in Tryon's 'Manual of Conchology' *Xenothauma* would probably rank as a genus; its systematic position may perhaps prove to be near *Epiphragmophora* of Doering.

Amphidromus sumbaensis, sp. n.

Shell sinistral, oblong-conic, narrowly perforate, solid; whorls $6\frac{1}{2}$, convex, first two of a pale purple colour, lower whorls cream to pale yellow below, ornamented with oblique bluish-grey stripes, which are crossed at upper whorls by interrupted spiral lines of a darker colour; apex dark brown; lip slightly expanded and reflected, pale purple; columella thick, purple, connected with the lip by a thin red callus.

Long. 34 millim., maj. diam. 16 millim.

Type in British Museum.

Loc. Sumba (Soemba) Island.

Allied to *latistrigatus*, Schepmann, but easily separated by its narrower form, the dark coloration of apical whorls, and its less solidity.

Amphidromus kalaoensis, sp. n.

Shell sinistral, polished, oblong-conic, almost imperforate; whorls 6, convex, obliquely striate, first two white, with dark brown apex, lower whorls yellow, with two spiral bands of equidistant square and oblong dark brown spots, one situated below and the other just above the suture; in addition the last whorl has a similar but wider band just below the periphery, and a continuous band above the dark brown umbilical area; lip and columella white, the former slightly expanded, the latter thickened at point of insertion but not reflected, both connected by a thin transparent reddish callus, which invests the parietal wall.

Long. 32 millim., maj. diam. 16 millim.

Type in British Museum.

Loc. Kalao Island (Everett).

This species is nearest to the Celebes form I described as *A. contrarius*, var. *maculata**, which I now think is distinct from *contrarius* and might be conveniently classed as a species.

* Ann. & Mag. Nat. Hist. ser. 6, vol. xvii. 1896, p. 78, pl. vii. fig. 4.

Kalaoensis can be separated from *maculatus* by its more convex whorls, its non-expanded columella, and its shorter aperture.

Porphyrobaphe approximata, sp. n.

Shell ovate-conic, solid, with distinct close oblique striæ; ground-colour tawny yellow, with irregular small patches of darker colour immediately above the sutures; last half volution has a peculiar burnt appearance; a narrow dark-coloured spiral band commences just above the middle of the second whorl, and is continued downwards to the last whorl, widening and fading away as it reaches the edge of the aperture; a broad burnt brown band about 4 millim. wide encircles the last whorl just below the middle; umbilical area covered with an ill-defined broader band of the same colour; nucleus (first $2\frac{1}{2}$ whorls) clearly defined, covered with oblique rows of close-set punctures; whorls $6\frac{1}{2}$, slightly convex; suture of lower part with a white thread-like line; peristome slightly spread outwards at lower part, somewhat thickened, but not reflected; peristome, columella, and parietal wall of a very dark purple colour, which extends about 4 millim. into the interior of the aperture, fading to violet, and from that to white; columella almost perpendicular, with a prominent projecting fold at the upper part.

Long. 67 millim., maj. diam. 31 millim.

Type in British Museum.

Loc. Bogota.

This species is intermediate between *Powisiana* and *atramentaria*; it is distinguished from the first-named by its stronger oblique striation, its darker colour, and different banding; from *atramentaria* it can be separated by its less prominent oblique striation, and it has not the mottled markings of that species. It can be distinguished from both the foregoing by its almost perpendicular columella and the very prominent projecting fold thereon; in both *Powisiana* and *atramentaria* the columella is strongly curved, and this character appears to be constant.

Porphyrobaphe vicaria, Fulton.

= *Bulimus labeo*, Rve. (pars), Conch. Icon., *Bul.* pl. lxxi. fig. 207 b, pl. lxxii. fig. 207 c; non Brod. Zool. Journ. vol. iv. p. 222, pl. supp. xxxi.; non Rve. Conch. Icon., *Bul.* pl. xxxv. fig. 207.

Type in British Museum (Cuming Collection).

Loc. Leimabamba, Peru, 8000 feet (*O. T. Baron*).

In his monograph of the genus *Bulimus* Reeve figured the

true *B. labeo* of Brod. on pl. xxxv. fig. 207, but afterwards figured the present species, stating that in his opinion the latter was the normal condition of *labeo*, and the former probably an abnormal form. Since then other specimens of both *labeo* and *vicaria* have been obtained, and they show that the two are distinct species.

The present species can be distinguished from *sublabeo*, Ancy (= *Yatesi*, var. *sublabeo*, Dohrn, MS.), Bull. Soc. mal. Fr. vii. p. 153, by its light olive colour, the almost entire absence of markings, and the dark purple-brown colour of the columella and parietal wall. The remarkable development and curious punctured peristome of *labeo* separates it easily from *vicaria* and all other known species of the genus.

XV.—*Observations on some Buprestidæ from the West Indies and other Localities.* By CHARLES O. WATERHOUSE.

A FEW Buprestidæ have been submitted to me for determination by the West-India Committee of the British Association. They are as follows:—

1. *Psiloptera Guildingii*, Hope, from Mount Gay Estate (leeward side), Mustique Island, Grand Ance (south end), and Bequia Island, Grenada (*H. H. Smith*). These are all of a bluish green, the one from Bequia Island being the darkest. A small specimen ($6\frac{1}{2}$ lin.) from Union Island is a bright golden green and very much resembles *P. clara*.

2. *Chrysobothris tranquebarica*, Gm., from Caliveny Estate (windward side), Grenada (*H. H. Smith*).

3. *Chrysobothris pulchra*, L. & G., from St. George's (leeward side), Woburn (south end), and Mustique, Grenada (*H. H. Smith*).

4. *Mastogenius uniformis*, sp. n.

This species I have described below. My first impression was that it must be made the type of a new genus; but an examination of some allied forms has convinced me that this would be premature.

MASTOGENIUS.

This genus was founded on a species from Chili. With it has been associated a North-American species which Le Conte

described as a distinct genus under the name *Haplostethus*. If these species are to be considered as congeneric I see no reason why the following species may not all be included in the genus. There is considerable difference in the length of the basal joint of the tarsi, in the prosternal antennal groove, and in the form of the insects; but these are probably only specific differences. It seems to me not improbable that when these small and apparently rare insects are better known, the genus may be as world-wide in its distribution as *Agrilus*.

Two of the species I merely indicate without naming them, as I have only single specimens in imperfect condition; one of them, moreover, is without locality. The species which I have named *M. uniformis* is the most distant from the type species, its sculpture (both above and below) is peculiar, appearing like flattened granules. *M. felix* and the two other species indicated are near the typical *Mastogenius*, but are shorter, more convex, and have the thorax shaped more as in *Cardiophorus asellus* &c. The difference in the form of the apical segment of the abdomen may be sexual.

Mastogenius uniformis, sp. n.

Aureo-æneus, convexus, sat nitidus, subtiliter punctulatus; capite convexo, fronte vix canaliculata; thorace lateribus leviter arcuatis, basi truncato; elytris subparallelis, apice arcuatim attenuatis; antennis pedibusque fere nigris, tarsis brevibus flavescensibus.

Long. 2 mill.

Hab. Mount Gay Estate (leeward side), Grenada, W. I. (*H. H. Smith*).

I do not know of any Buprestid quite of this form; it reminds me somewhat of *Aurigena* in its outline, but has the thorax rather broader and more convex. The surface, when examined with the microscope, has somewhat the appearance of leather. Head convex, finely and not very closely punctured, with a slight median impressed line; below with a groove bordering the eye for the reception of the basal joints of the antennæ, the groove continued on to the sternum, but becoming gradually narrower and terminating about halfway between the front margin and the coxæ. Antennæ as long as the head and thorax together, the two basal joints moderately stout, the third joint rather slender, the following joints triangular, the terminal joint elliptical. Thorax transverse, convex, almost rectilinear at the base, not much narrowed at the base, arcuately rounded at the sides; finely and not very closely punctured. Scutellum rather small, curvilinear.

Elytra at the base not quite as broad as the broadest part of the thorax, about three times as long as the thorax, with a very slight transverse impression at the base, without other impressions; the punctuation irregular, fine but distinct, the punctures moderately separated from each other. Underside sculptured as above. Front and intermediate coxæ rather widely separated. The prosternal process broad, flat, parallel, truncate posteriorly, and fitting close to the metasternum, the process bordered on each side by a distinct but fine line, the lines diverging slightly as they approach the anterior margin of the prosternum; with a few large shallow punctures. Abdomen with no division between the first and second segments, together about half the length of the abdomen, the third and fourth short, the fifth semicircular. Tarsi short, the first joint scarcely longer than the second. Claws dilated at the base, the dilatation appearing in some positions like a large triangular tooth.

From the foregoing description it will be seen that this species differs from the typical species of *Mastogenius* in having a groove in the sternum for a portion of the antennæ, and in having the basal joint of the tarsi short &c.

Mastogenius felix, sp. n.

Oblongus, subparallelus, æneus, convexus, nitidus; capite leviter convexo, crebre evidentè punctato, medio vix sulcato; thorace elytris latiori, bene convexo, subtiliter crebre punctulato, lateribus rotundatis anguste marginatis; elytris subparallelis, ad apicem arcuatim angustatis, crebre subtiliter punctulatis, sub humeris leviter compressis, basi transversim impressis.

Long. $2\frac{3}{4}$ mill.

Hab. Transvaal.

The prosternum of this species has scarcely any trace of the groove mentioned in the foregoing species; the fine lines bordering it are rather more parallel, the surface appearing smooth, rather strongly and rather closely punctured (the punctures separated from each other by about the diameter of a puncture). Abdomen with the punctures not quite so close as on the prosternum, round, rather finer, each bearing a fine whitish hair; the apical segment emarginate in the middle. Antennæ rather slender, the two basal joints moderately large, the third slender, the fourth an isosceles triangle, a little longer than the third, the fifth about the same length, but broader at the apex, the following a little shorter. Tarsi with the basal joint about as long as the two following taken together.

Mastogenius, sp.

Niger, nitidus, convexus, crebre punctatus.
Long. $2\frac{3}{4}$ mill.

Hab. Hong Kong.

This species much resembles *M. felix*, but is black. The thorax is more rounded at the sides, much resembling the thorax of some *Cardiophori*. The prosternum has a distinct trace of the antennal groove; the surface appears smooth, the punctures distinct, separated from each other by about two diameters of a puncture; the fine lines bordering the sternum gently curved. Tarsi with the basal joint about equal to the two following taken together.

Mastogenius, sp.

Niger, nitidus, crebre sat fortiter punctatus.
Long. 3 mill.

Hab. ——. Received from the "Entomological Club."

Very close to the preceding, but much more strongly punctured. The head is much more distinctly sulcate. The thorax a little more convex.

XVI.—*New Species of Pyralidæ from the Khasia Hills.*

By W. WARREN, M.A., F.E.S.

[Continued from vol. xvii. p. 466.]

Subfamily *Pyraustinæ*.

Genus *Syllythria*, Hübn.

Syllythria metallica, sp. n.

Fore wings yellow; the costa and hind margin broadly metallic purple; a black discal spot and another before it in the cell; antemedian, median, and postmedian lines blood-red, united in places by blood-red lines along the veins; the purple marginal line tinged with red internally; fringe yellow, with red base. Hind wings white, somewhat yellowish tinged; a metallic purple blotch on hind margin in middle, preceded by some red scales. Head, face, thorax, and abdomen yellow, with red scales intermingled. The whole surface of both wings and of body is dusted with

shining scales. Underside pale yellow; costa of fore wings broadly purple-black, costa of hind wings near base somewhat shouldered and fringed with long reddish hairs.

Expanse of wings 13 millim.

One male from the Khasias.

Genus LEPIDOPLAGA, Warr.

Lepidoplaga longicorpus, sp. n.

Fore wings quite as elongate as in *elongalis*, Warr., the yellow ground-colour intermediate between the pale yellow of that species and the deep yellow of *flavofimbriata*, Moore; the fuscous suffusion as deep as in the latter; the lines much more distinct; the outer line starting from a dark brown costal spot at two thirds; in the hind wings this line is curved, not straight, and only visible in the centre of the wing, not reaching nearly to the hind margin; the narrow yellowish marginal space with a series of distinct black dots in both wings, those of the hind wings almost contiguous. Thorax and abdomen dark fuscous, the abdomen as long as the fore wing. Underside darker grey, with the tufts leaden grey. Fore tarsi white.

Expanse of wings 20 millim.

One male from the Khasias.

In this species the costa of fore wings becomes yellow only towards apex, whereas in *elongalis* it is broadly pale yellow throughout; the hind wings are narrow and not elbowed in the middle of hind margin.

Lepidoplaga elongalis, sp. n.

Resembles *L. flavofimbriata*, Moore (*Mabra*), but the wings narrower, more elongate; the yellow ground-colour and the fuscous-grey suffusion alike paler; the fovea beyond the cell, which in *flavofimbriata* is slightly before the middle, is here rather beyond the middle and more elongate; the outer line is much less distinct, rising at barely two thirds, whereas in *flavofimbriata* it rises at three fourths, and, instead of being curved at once from the costa, runs out slightly oblique to the second median, along which it goes inwards to the end of cell and then straight to inner margin; the first line is only faintly perceptible, oblique. Hind wings with costal region pale; traces of a dark outer line, which runs from two thirds of costa nearly straight to hind margin, before which it curves towards anal angle; the pale yellow hind margin of both wings is entirely unmarked by black dots. Underside

of both wings glossy grey, with all the margins yellowish; both the scale-tufts much larger than in *flavofimbriata*, that at end of cell being greatly extended, nearly one third as long as the wing and much whiter; the hind wings are broad, with a perceptible elbow in middle. Fore tarsi yellow.

Expanse of wings 18 millim.

Several males from the Khasias.

Genus CIRCOBOTYS, Butler.

Circobotys aurimargo, sp. n.

Fore wings fuscous, with a reddish tinge; the costa more narrowly, the hind margin more broadly, yellow; the lines very indistinct; antemedian at one fourth, oblique outwards; postmedian at two thirds, vertical to middle, then running straight inwards, and again vertical to inner margin at middle; discal spot and another before it in the cell, both very obscure; fringe yellow. Hind wings like fore wings, but the hind margin not so broadly yellow and ground-colour paler, semitransparent. Head, thorax, and abdomen ochreous fuscous. Underside like upper, but paler. Wings of male narrower and more elongate than of female.

Expanse of wings 28 millim.

A fair number from the Khasias.

POLYCHORISTA, gen. nov.

♂. Fore wings narrow; costa straight for two thirds, then convex; apex much produced, but not acute; hind margin very oblique, scarcely curved; anal angle indefinite. Hind wings twice as wide as fore wings, triangular; both angles rounded, but prominent; hind margin nearly straight, with a bend shortly before anal angle; costa strongly shouldered at base. Abdomen of male very long, with large anal tuft. Thorax large, hairy, with bushy patagia; antennæ (♂) simple, three fourths of the length of wing; forehead slightly produced below; labial palpi rostriform, broad, porrect; maxillary palpi slender, filiform; tongue and ocelli present; middle tibiæ much enlarged and flattened; hind tibiæ with four spurs, the outer ones very long, the inner short; a pair of scaly flaps from abdomen behind the hind legs. Neuration: fore wings, cell not half as long as wing, narrow; discocellular concave outwards; first median at one half, depressed at its origin, and preceded by a hyaline impression, more or less hidden above by long hairs from the base of the wing; second median close before the end, third from the end

of cell; lower radial from shortly above the angle; upper radial and fifth subcostal from upper angle of cell, the stalk of the third and fourth from just before the angle, the second closely approximated to it; first subcostal remote, before two thirds. Hind wings with cell excessively short, the angulation of the discocellular running up nearly to base; the costal vein strongly developed at base; the two subcostals from angle of cell, the first anastomosing for a considerable distance with the costal; radial from the lower arm of discocellular; last two medians from the end of cell, first at one half.

Type *Polychorista calvatalis*, Swinh. (*Thliptoceras*).

Col. Swinhoe's type was a female. The structure of the male removes it from *Thliptoceras*.

Genus PROTONOCERAS, Warr.

Protonoceras lugens, sp. n.

Fore wings dark mouse-colour, with the lines blackish, thick, first close to base, second at three fourths, vertical from costa and on inner margin beyond middle, and forming a shallow bidentate sinus between; a rather large cell-spot; fringes unicolorous except above anal angle, where there is a small white spot. Hind wings somewhat darker, with blackish cell-spot and outer line as in fore wings; white spot in fringes larger and further from anal angle. Head, thorax, and abdomen concolorous. Underside of wings, body, and legs bluish white, with all the markings distinct, blackish; palpi blackish externally.

Expanse of wings, ♂ 24, ♀ 30 millim.

Several from the Khasias.

Genus EBULEA, Guen.

Ebulea? anomalalis, sp. n.

Fore wings mouse-colour, with a thick dusting of lengthened ochreous scales; the lines darker, first at one fourth, curved to inner margin at one third; basal area darker, with a subbasal reddish shade or fascia; second line at three fourths, forming the usual sinus in the middle, but not running in so far as usual, and reaching inner margin at quite two thirds; discal spot dark; fringe grey, with two darker lines; a row of very minute pale spots at end of veins. Hind wings the same, without first line. Head, thorax, and abdomen all concolorous. Underside paler, especially of the hind wings; outer line darker in both wings and forming

dark spots on veins. Antennæ lamellate and subdentate, not simply filiform and pubescent, as usual in *Ebulea*, but the neururation is identical with that of *E. intensalis* and *ochreipunctalis*, to which it appears most allied.

Expanse of wings 26 millim.

One male from the Khasias.

Ebulea decoloralis, sp. n.

Fore wings reddish ochreous, with all the basal half suffused with dull brown, giving the wing a smoky appearance. The lines dark fuscous, first from one fourth of costa to one third of inner margin, slightly wavy; second from three fourths of costa to two thirds of inner margin, very wavy, and describing a broad but shallow sinus outwards in midwing, and approaching first line on inner margin; orbicular stigma small, round; reniform lunular, its lower end touching a diffuse darker brown blotch; fringes dark brown, rather lighter towards apex, with a fine light brown line at base. Hind wings like fore wings, without the first line; costal area whitish, basal area darker, more mixed with grey than that of fore wings; fringes dark brown, but pale at anal angle. Head, palpi, thorax, and abdomen smoky brown; anal tuft of male yellowish ochreous. Underside of fore wings ochreous, tinged with rusty, the base cinereous; of hind wings ochreous yellowish; the fringe of both wings dark brown.

Expanse of wings 30 millim.

A male and female from the Khasias.

Akin to *Ebulea intensalis*, Swinh., but differing in colour, the wings narrower, basal line of fringes without whitish spots.

Ebulea ochreipunctalis, sp. n.

♂. Fore wings dull reddish fuscous, with fine dark irroration; the colour much as in *E. intensalis*, Swinh.; the lines darker, first at one fourth, oblique outwards to inner margin beyond one third, second at three fourths, oblique from costa, then forming a sinus with four teeth (often marked as spots), shortly incurved, but not as far as the discocellular, and reaching inner margin at two thirds; a dark obscure discal spot; fringes concolorous with dark basal line, preceded by a row of yellow dots at end of veins. Hind wings dark fuscous, with darker curved and dentated outer line; the disk much suffused with darker and the hind margin tinted with reddish; fringe as in fore wings, with a pale ochreous line at base. Head and thorax like fore wings; abdomen cinereous, with whitish anal tuft. Underside of fore wings

reddish, grey in the disk; of hind wings ochreous, suffused with reddish towards margins; both wings with outer line of red-brown dots on veins.

♀. Fuscous, without any reddish tinge; the costa of fore wings fulvous ochreous on each side of the outer line.

Expanse of wings 32 millim.

Several from the Khasias.

The male is very much like *E. intensalis* of Swinhoe, but is without the dark discal blotch, and the outer line is rather different in its course.

EBULEODES, gen. nov.

Like *Ebulea* in build and appearance, but separated by several points: the antennæ of the male are lamellate, pubescent; the basal joint porrect, forming a hollow sheath, out of which the shaft rises at right angles; labial palpi porrect, rostriform, the second joint bent above in the middle; maxillary palpi very small; ocelli present; the male has a tuft of hair from base of inner margin of fore wings, a comb of hair along the internal vein of hind wings, and the fringes very long and somewhat curled from halfway up inner margin to end of the internal vein on the hind margin. Neuration: fore wings, cell half as long as wing; the discocellular oblique; first median at two thirds, second close to end of cell, third from the end; lower radial just above the end; upper radial and last subcostal rather approximated and both from the discocellular; second subcostal stalked with third and fourth.

Type *Ebuleodes simplex*, sp. n.

Ebuleodes simplex, sp. n.

Fore wings dull yellowish, with a slight greyish suffusion in parts; the lines grey, feebly marked, first from costa near base, running obliquely outwards to submedian fold, then nearly vertical to inner margin at one third; second at three fourths, also running at first obliquely outwards for one third, then straight towards anal angle as far as the first median, and, lastly, basewards with two sharp angulations to inner margin at two thirds, the upper two thirds formed more or less of lunular spots; a slight dark spot in cell and a grey lunule at the end; disk with a slight greyish cloud; fringe pale grey, glossy. Hind wings like fore wings, with the costal region whitish; a curved submarginal line not reaching the costa; fringe towards anal angle long and pale ochreous,

like the comb of hair on the internal vein and the tuft from base of fore wings. Head, thorax, and abdomen concolorous; palpi with basal joint white, second and third joints ochreous. Underside pale straw-colour, with only the outer line faintly indicated.

Expanse of wings 30 millim.

One male from the Khasias.

Genus PALIGA, Moore.

Paliga contractalis, sp. n.

Like *P. ochrealis*, Moore, but much smaller; the exterior line forming a smaller sinus, and more sharply angled below the sinus than in *ochrealis*.

Expanse of wings 24 millim.

Many examples from the Khasias and other places.

Genus ACHARANA, Moore.

Acharana subænescens, sp. n.

Fore wings greasy-looking, dull fuscous grey, with no distinct markings, the margins of the central field being indicated by pale ochreous shades, the inner curved and indistinct, the outer running from three fourths of costa nearly straight to the first median, thence inwardly along that nervule to near below the second discal spot, and then with an outward curve to inner margin at one third; the inner area where it touches these paler shades somewhat darker than the rest; two blackish spots in the cell, the outer the larger and darker, separated by a subquadrate patch of pale ochreous. Hind wings rather paler, with a dull brown discal spot and an angulated central shade, margined in parts with paler; fringe of both wings concolorous; both wings have a slight bronzy appearance. Head, thorax, and abdomen concolorous or rather darker than wings. Underside of wings paler, with all the markings more distinct; underside of abdomen and pectus shining white; legs white; fore tibiæ and spots on fore tarsi brown.

Expanse of wings 30 millim.

Two males from the Khasias.

PROPHANTIS, nom. nov.

The above name is proposed for the two species *octoguttalis*, Feld., and *castoralis*, Wlk. (= *purpurascens*, Moore), hitherto

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placed under *Archernis*, Meyrick, with the type of which, *Archernis callixantha*, Meyr., they are, however, not congeneric. To this genus a third species is now referred provisionally, the type being a female.

Prophantis? triplagalis, sp. n.

Fore wings shining, purplish grey; the costa and a line of marginal dots yellow; a square, pale yellow, dark-edged spot in middle of cell; a larger irregularly reniform blotch from costa beyond cell pale yellow, with darker dentate outer edge and a faint yellowish spot or two obliquely below it towards base; the outer dark edge really representing the postmedian line, which is faintly marked on the costa and can be traced to inner margin; fringe grey, with base darker. Hind wings like fore wings, with no inner spot. Head, thorax, and abdomen rather darker than wings; palpi dark purple, white beneath; tongue white; legs and abdomen beneath white; fore knees dark brown. Underside of wings duller than upper, with all the markings shown.

Expanse of wings 30 millim.

One female from the Khasias.

Genus MIMORISTA, Warr.

Mimorista marginalis, sp. n.

Fore wings yellow, suffused with fulvous brown; a dark subcostal streak, becoming fainter towards the postmedian line; costa above it brownish yellow, brighter yellow beyond the outer line; the lines thick, purple-brown, first near base, curved and somewhat oblique outwards; basal area fulvous; a round dark brown spot in cell, with paler centre; a square brown-edged stigma at end of cell, its centre purple-grey; a darker edged elongated oval stigma beneath the small spot in cell; a diffuse fuscous suffusion beyond the first line, extended along the median vein; space between the two cell-spots bright yellow; postmedian line at three fourths, irregularly dentate for first third, then describing a rounded sinus, curving upwards to beneath the discal spot, where it touches a purple spot between the first and second medians, then sinuous and oblique to inner margin before two thirds; a broad purplish-fuscous marginal band, not quite touching costa, with two curves on its inside and touching outer line at the bottom of the sinus; the veins slightly paler, and a row of pale dots along hind margin between them; fringe greyish yellow, with darker interrupted line near base. Hind

wings paler yellow, without suffusion ; a dark discal ring and squarely angled outer dark line ; marginal band as in fore wings, but hardly so wide. Palpi and face dark fuscous ; head and thorax fulvous grey ; two basal segments of abdomen yellowish, the rest fulvous, with white segmental rings. Underside dull yellow, with all the markings showing through.

Expanse of wings 30-33 millim.

A male and female from the Khasias.

Genus GONIORHYNCUS, Hmps.

Goniorhyncus marginalis, sp. n.

Fore wings pale yellow, with all the markings as in *G. obliquistriga*, Warr., but very much more developed ; the costa and hind margin broadly dark brown ; a diffuse brown streak along the whole of the submedian ; the veins from the lower end of cell to the sinus in the exterior line brown ; centre of discal mark with white scales, and a small white dot in the cell in the centre of the antemedian line ; fringe dark brown, with pale fine basal line. Hind wings the same. Head, thorax, and abdomen pale yellow, mixed with blackish ; the abdomen becoming orange towards the end. Underside dull yellow, with the markings hardly visible.

Expanse of wings 26 millim.

One male from the Khasias.

This may be a very strongly marked variety of *G. obliquistriga*.

Goniorhyncus obliquistriga, sp. n.

Fore wings pale yellow ; the costa somewhat broadly, the hind margin narrowly, dark brown ; a small brown dot below the costal stripe near base, and another on inner margin below it, representing the subbasal line ; a stronger brown dot at one third, with a vertical brown streak below it from the antemedian line ; postmedian line at three fourths, incurved at first, then vertical, then outcurved, vertical again over the three medians, acutely incurved to below the discal mark and obliquely inclined to inner margin beyond middle, closely approximated there to the first line ; reniform stigma hour-glass-shaped, the upper half the larger, bluish white, with thick dark brown edges, with a diffuse brown oblique streak from its lower edge to hind margin above anal angle ; fringe brown, with a pale line at base. Hind wings with discal spot and a very strongly angulated postmedian line brown ;

fringe and hind margin as in fore wings. Head, face, thorax, and abdomen yellow; collar narrowly brown; anal tuft of male large. Underside pale yellow, with the markings very scanty.

Expanse of wings 24 millim.

Two males from the Khasias.

CENOCNEMIS, gen. nov.

Differs from *Enchocnemidia*, Led., in the legs of the male not being tufted with hair, though the tufts on the under surface of the hind wings are present as in that genus.

Type *Cenocnemis incurvata*, sp. n.

Cenocnemis incurvata, sp. n.

♂. Fore wings bright green, with the extreme costa at base and apex fuscous; fringes fuscous, ochreous at base; a scarcely perceptible blackish dot on discocellulars; the hind margin is slightly incurved in its lower third. Hind wings with the hind margin strongly incurved below the middle, bright green, with the costal and inner margins whitish, and a whitish streak along the submedian fold and the internal vein; a very conspicuous brown-black elongated cell-spot; fringes as in fore wings, with some dark spots in front of the pale base along the indented part. Head, face, palpi, thorax, and abdomen all bright green; anal tuft black. Underside paler, bluish green; the fore knees brown; the hair-tufts on the hind wings pale ochreous.

♀. Like male, but the hind margin of hind wings fully rounded, not incurved.

Expanse of wings, ♂ 36, ♀ 38 millim.

A pair from E. Java.

Genus ENCHOCNEMIDIA, Led.

Enchocnemidia fuscitibia, sp. n.

Fore wings and fringes green; the costa faintly paler; a very minute dark cell-dot. Hind wings green, with costal area whitish. Head, face, palpi, thorax, and abdomen green; anal tuft whitish, dark grey at base and blackish beneath. Underside paler; the fore knees brown; tufts on hind wings pale ochreous; tufts on hind legs pale fuscous externally, dark grey internally, much smaller than in *E. phryneusalis*.

Expanse of wings 34 millim.

One male from Tenimber.

Genus PAROTIS, Hübn.

Parotis planalis, sp. n.

Fore wings bright green, with the costa broadly reddish ochreous; fringes grey, with their base greenish; no trace of cell-spot. Hind wings green, with costal and inner marginal areas paler; fringe ochreous grey, paler towards anal angle; no cell-spot. Head, face, thorax, and abdomen bright green; anal tuft dark grey; palpi bright brown. Underside paler; the costa and costal fringe ochreous.

Expanse of wings 30-33 millim.

Two males from Dili.

Genus GLYPHODES, Guen.

Glyphodes pedenotata, sp. n.

Fore wings white, with olive-ochreous and purplish-brown shades; inner margin broadly white at base, the base above the white being marked with purple-brown, which colour extends some way along the submedian vein, and below that vein beyond the recurved internal vein, the base olive-ochreous; an oblique antemedian olive-ochreous streak edged with brown, separated by a narrow oblique streak of white from the basal area, which is also edged with brown; it is followed by a broader white oblique space, edged with brown and ending in an acute point; from centre of costa two darker olive fasciæ with dark purple edges and separated by a narrow white interrupted space run nearly across the wing; the first of these below the middle becomes purple and contains a white streak on its inside; these are followed by a broad white blotch from the costa, bluntly rounded beneath, and with a projection externally pointing towards the apex; postmedian line white, broader above, elbowed opposite the cell, then oblique and parallel to hind margin, the space between it and the costal white blotch being filled in with dark purplish brown; marginal area purplish grey, divided into two fasciæ by a paler line, which, like the white postmedian line, is diffusely edged externally with dark purple; the outer of the two fasciæ is limited above by an oblique line from apex, before which there is a triangular white costal spot; fringe purplish grey, with a dark purple basal line; all the markings are paler above the subcostal vein, and are limited below by the submedian vein as far as the postmedian line. Hind wings with more than the basal half white, tinged with violet-grey, and with a dark discal mark; the

marginal area like that of the fore wing from the postmedian line outward, this line being in the hind wing edged internally by a thick purple-brown line, which, like the postmedian itself, is bent and angled before the anal angle along the hind margin. Palpi and antennæ white; head and centre of thorax apparently ochreous; patagia white; abdomen ochreous. Underside dull whitish, with the dark upper markings showing indistinctly through.

Expanse of wings 32 millim.

One female from Lifu.

Distinguished from the allied forms by the shape of the oblique white costal blotch with its purple-brown external edging.

Glyphodes tumidalis, sp. n.

Intermediate in size between *conclusalis*, Wlk., and *violalis*, Warr.; distinguished by the larger swollen second white hyaline spot of the fore wings, round which the somewhat whiter postmedian line is rather bent. In the hind wings the dark marginal border is of nearly uniform width throughout, not, as in the other two species, broadened out towards apex, and its internal edge is therefore nearly straight; like *violalis* the whole marginal area is dark and the violet shade straight and near the centre; fringe of fore wings often wholly dark, the basal dark line always entire; of fore wings white throughout, and without a dark basal line except just before anal angle.

Expanse of wings 30 millim.

A few from Sikkim.

Glyphodes violalis, sp. n.

Like *G. conclusalis*, Wlk., but larger; differing in the following points:—In *conclusalis* the violet postmedian line follows *immediately* after the second of the two hyaline spots, is more strongly concave, and slightly bent both below the costal white spot and before that on the inner margin; in *violalis* a fairly broad deep purple space separates the spot from the line, which is uniformly curved from end to end; in *conclusalis* the dark edging of the postmedian line is followed immediately by a dull violet shade; in *violalis* this violet shade is much nearer the centre of the dark marginal area; this difference is still more evident in the hind wings, where in *violalis* the violet shade runs nearly straight from anal angle through the middle of the dark purple margin, while in

confusalis it follows closely the inner edge of the dark fascia, and the fascia itself is darkest in the centre, and becomes again tinged with violet towards the hind margin. There is generally present a third much smaller white spot towards the base of cell of fore wings. In both forms the white fringes have a broad dark basal line, which is interrupted above the anal angle of both wings, and the whole of the fringe at the middle of each margin is dark from base to apex.

Expanse of wings 34 millim.; *conclusalis* expands 26 to 28 millim.

In Walker's description of *conclusalis* he calls the first of the two white spots in the fore wings a white "dot," and the spot is, in fact, very small in the type specimen; but, as a rule, the first spot forms an oblique oval; in *violalis* both spots are in general narrower towards the inner margin than in *conclusalis*.

[To be continued.]

MISCELLANEOUS.

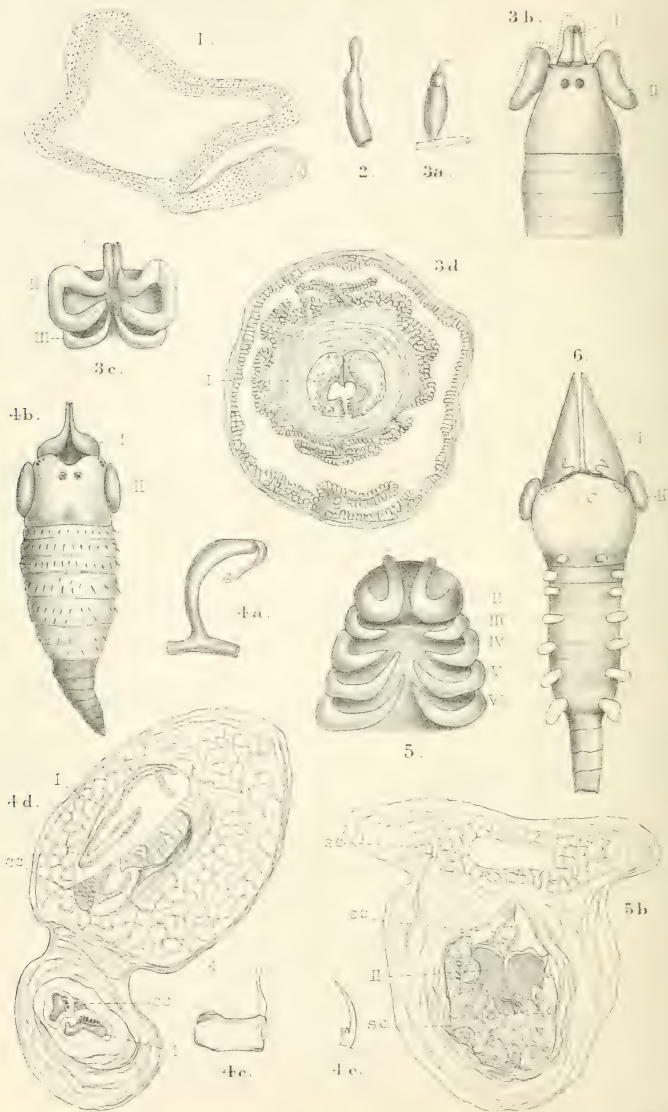
On a Collection of Barnacles. By H. A. PILSBRY.

THE barnacles described were obtained from the bottom of the iron ship 'Puritan' of Glasgow, which had been dry-docked in Cramp's shipyard after a voyage from San Francisco to Hong Kong, and to Philadelphia via Java and India. The forms represented were *Balanus tintinnabulum*, L., *B. tintinnabulum zebra*, Darwin, *B. tintinnabulum spinosus*, Gm., *Tetracita porosa patellaris*, Darwin, *Lepas anatifera*, L., and *L. Hillii*, Leach. The forms ranked as varieties of *B. tintinnabulum* retain their individuality perfectly, although growing side by side under apparently identical external conditions, so that their differential characteristics can scarcely be attributed to unlike environmental factors. The variety of *Tetracita porosa* seems to be a rare form, originally described by Darwin from three examples taken off a ship's bottom in Boston by Dr. A. A. Gould. It is very unlike the ordinary form of the species. Specimens of *Ostrea rivularis*, Gld., are attached to some of the barnacles. As this is a species of East-Asian seas, it is very probable that the load of barnacles was obtained in China, although the Balanidæ themselves have been so widely diffused by commerce that alone they afford but little evidence of their original patria. The specimens were procured and presented to the Academy by Master Lester Bernstein. — *Proc. Acad. Nat. Sci. Philad.*, March 31, 1896, p. 208.

Theoretical Explanations of the Distribution of Southern Faunas.

By Captain F. W. HUTTON, F.R.S.

After reviewing the various theories which have been offered to explain the difficult and intricate problem of the distribution of southern faunas, the author points out that the supposition that the ancestors of certain groups migrated from the northern into the southern hemisphere by the present continents, and have since then become extinct in the north, explains a good deal, but fails to give a full and satisfactory explanation of the whole of the facts. Moreover, the members of the fauna unaccounted for are old forms, and consequently the means of communication which served them must long ago have been destroyed. To the author a fatal objection to the theory of migration by way of an Antaretic continent is offered by the following consideration. Aplacental Mammals—both Multituberculata and Polyprotodontia—existed in Europe and North America in the Triassic and Jurassic periods, and these Polyprotodontia were, no doubt, the ancestors of the living Polyprotodontia of Australia. In the Eocene strata of Patagonia remains of a large number of Polyprotodontia have been found which are far more closely related to the Polyprotodontia of Australia than to the Mesozoic forms of Europe and North America; consequently a direct land communication must have existed between these two southern countries. Now there is strong geological and palæontological evidence that no land-ridge existed between North and South America during the Mesozoic and early Cainozoic eras; consequently we must assume that the southern forms migrated through the Malay Archipelago, and, if they went to Patagonia by means of an Antarctic continent, they must have passed through Australia. But mingled with the Eocene marsupials of Patagonia there are a number of Eutheria of typically South-American character—Edentata, Toxodontia, Typotheria, Perissodactyla, Rodentia, and even Platyrrhine monkeys—without any northern forms of Artiodactyla, Carnivora, or Insectivora; and it is hardly possible that these should have passed through Australia without leaving any record behind. The theory of the former existence of a South Pacific Mesozoic continent, first suggested by Huxley, seems to be the only theory left. It not only explains the origin of the Australian and South-American marsupials, but also the almost simultaneous appearance of different Eutherian mammals in North and South America. We must suppose that this continent threw off first New Zealand, then Australia, then Chili, and finally disappeared under the waves. At a later date New Zealand must have formed part of a large island joined to New Caledonia, but not to Australia. The objections to this theory are geological rather than biological, involving the doctrine of the persistence of continental and oceanic areas upon which geologists are not agreed; and such objections are equally applicable to the theory of an Antaretic continent.—*Linn. Soc. New South Wales, Abstract of Proceedings*, April 29, 1896, pp. ii, iii.



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XVII.—*Further Notes on the Anatomy and Development of Scorpions, and their bearing on the Classification of the Order.*

By MALCOLM LAURIE, B.A., D.Sc., F.R.S.E., F.L.S.,
Professor of Zoology at St. Mungo's College, Glasgow.

[Plate IX.]

SINCE the publication of my former notes on this subject * I have had an opportunity of examining a number of species of Scorpions belonging to typical genera. This opportunity I owe to the kindness of Mr. Pocock, of the British Museum, and I gladly take this opportunity of thanking him. While sufficient material has not yet been examined to enable me to base a complete classification on it, nevertheless a number of interesting facts have been ascertained with regard to the development, and it seems better to publish these without waiting for the problematical arrival of further material. This is the more advisable as I find it necessary now to revise some of the conclusions to which my earlier observations seemed to lead. As a general result I am more than ever convinced of the great value of the mode of development as a basis for classification, and am inclined to consider the structure of the lung-book lamellæ of subordinate but considerable value.

* Ann. & Mag. Nat. Hist., March 1896.

I. THE LUNG-BOOKS.

The results of an examination of the lung-books of a few forms in addition to those described in my previous paper may be very briefly stated. They all came under two types:—

(1) *Spinous type.*

SCORPIONIDÆ: *Ischnurus ochropus*, Koch; *Hadogenes troglodytes* (Pet.); *Hemiscorpius lepturus*, Pet.

IURIDÆ: *Anuroctonus phæodactylus* (Wood); *Broteas Herbsti*, Thor.

BOTHRIURIDÆ: *Cercophoniæ squama* (Gerv.).

(2) *Reticulate type.*

Butheolus thalassinus, Sim.; *Heterocharmus cinctipes*, Poc.; *Chærilus variegatus*, Sim.

The reticulate forms are of special interest. Hitherto I have only found this structure in the Butliidæ, and am inclined to consider it as characteristic of them. *Butheolus* and *Heterocharmus* are both somewhat aberrant forms of this family. *Heterocharmus* has a pentagonal sternum, and its close ally (if, indeed, the two are distinct genera), *Charmus*, Karsch, was placed by its author in the subfamily Iurini of the Pandinoidæ of Thorell. The possession of reticulate lung-book lamellæ is strong confirmation of the accuracy of their present position. *Chærilus variegatus* is also an aberrant form, having among other points of interest circular stigmata. Pocock places it in a subfamily by itself among the Iuridæ, but its position seems somewhat uncertain, and the lung-books are strong evidence in favour of a relationship to the Butliidæ.

II. DEVELOPMENT.

The terms I have hitherto used to define the two chief types of development will no longer serve, because there are so many variations from the type in each case that to speak of *Scorpio* and *Euscorpius* types of development is misleading. The fundamental difference is that while in the one case, what I have described as the *Euscorpius* type, the egg early leaves the follicle in which it is formed and passes into the cavity of the ovarian tube, in the other case (*Scorpio* type) the egg develops *in situ*, and as the embryo becomes too large for

the follicle it extends down and occupies a diverticulum from the ovarian tube, at the distal end of which the egg is originally formed. I would suggest apoikogenic and katoikogenic* as, for the present, adequately designating the two modes. The katoikogenic (*Scorpio* type) forms are always, so far as observation has yet gone, devoid of any appreciable amount of food-yolk. The apoikogenic ones, on the other hand, usually contain a large amount of food-yolk, but, as we shall see, there are certain exceptions (*Scorpiops*, *Vejovis*, &c.). In the apoikogenic forms also there appears always to be a double embryonic membrane formed at an early stage, the outer layer of which, usually termed the serous membrane, is easily distinguished by its large cells containing enormous flattened nuclei. I have been unable to find these membranes in the katoikogenic embryos.

The diverticula at the ends of which the katoikogenic eggs are formed seem always to terminate in a solid cord of cells—the appendix. The central core of this appendix consists of cells characterized by thick, highly refractive cell-walls and little or no protoplasm. These cells appear to form a means of communication down which the nutritive secretion passes from the outer cells of the appendix to the embryo. The material supplied in this way is usually taken in through the mouth of the embryo, which is one of the earliest structures to be developed. Some of the further specializations for the nutrition of the embryo in these katoikogenic forms are described below. They form a most interesting series, and, taken along with the forms I have previously described †, seem to afford a good basis for classification.

A. Apoikogenic Forms.

Scorpiops Hardwickii (Gerv.).

The embryos of this species appear at first sight quite similar to those of *Euscorpius*, their position in the ovarian tube being marked in my specimen by oval swellings about 2 millim. long and 1 millim. wide. Sections, however, show that while this form agrees with *Euscorpius* in the place in which the embryo develops, it differs markedly from it in the type of development. We find the inside of the swelling on the ovarian tube lined throughout by a double cellular

* From ἀποικος, away from home, and κάτοικος, at home.

† "Development of *Scorpio fulvipes*," Quart. Journ. Micr. Sci. vol. xxxii.; "Some newly-hatched Specimens of *Opisthophthalmus*," Proc. Roy. Phys. Soc. Edinb. 1896.

membrane, the outer layer of which is easily recognized by the enormous flattened nuclei of the cells as the "serous membrane," the inner membrane being the amnion. In *Euscorpis* we find these two membranes closely surrounding the embryo, and in early stages extending beyond the embryonic area over the yolk. In *Scorpiops*, however, there is no yolk, and the membranes surround a space at one end of which the embryo is developing. My specimen was in a comparatively young stage, and the embryo only occupied about one fourth of the space surrounded by the embryonic membranes. The walls of the ovarian tube are very thick and the cells probably secrete nourishment.

As there were embryos present there were only eggs in a very early stage of formation. Judging from them, the eggs seem to be formed in a pedunculated follicle, and not sessile on the ovarian tube, as in *Euscorpis*.

This type of development brings this form into close relationship with *Vejois*, in which, as I pointed out in my former paper, there is little or no yolk. The absence of yolk and the pedunculated ovarian follicles give us a transition form towards the katoikogenic type of development.

Iurus Dufourei (Brullé). (Pl. IX. fig. 1.)

Of this form I have unfortunately not been able to get any embryos. The ovarian tube (fig. 1) is very large and contains a considerable amount of coagulum. The unfertilized ova of my specimen are very small, measuring .15 millim. by .1 millim. They are contained in a follicle borne on a stalk, and in this, as in their small size, resemble the structure found in *Scorpiops*. I believe the ova were ripe and had attained their full size, because the surrounding follicle-cells were apparently degenerating. I have no doubt the development will prove to be very similar to that of *Scorpiops*.

B. Katoikogenic Forms.

Hemiscorpis lepturus, Pet. (Pl. IX. fig. 2), and *Diplo-centrus Whitei* (Gerv.).

Of these two genera, representing subfamilies in Pocock's classification, I have only been able to get ovaries containing unfertilized eggs.

The structure of the diverticulum, appendix, &c. in both these species so closely resembles that of *Scorpio* and other forms that I have no doubt the development is katoikogenic, but no further details could be ascertained.

Urodacus novæ-hollandiæ, Pet. (Pl. IX. figs. 3 a-d.)

The embryos of this form in my possession are in an advanced stage of development, the eyes, limbs, &c. being all well formed; they measure about 12 millim. in length and are markedly cylindrical. The appendix is short and there is a well-marked thickened portion at the top of the diverticulum. Removed from the follicle the embryo appears as in figs. 3 b & c. The chelicerae project straight out in front and are of considerable length, terminating in a cup placed towards the inner side. From this cup an incomplete groove seems to run between the two chelicerae down towards the mouth. This groove is partly closed in at its posterior end by processes from the basal joints of the chelæ (fig. 3 c). The central cord of the appendix terminates close to the distal end of the chelicerae.

The chelæ have their elbows well forward in front of the carapace and project into a fold of the surrounding diverticulum, as is indicated by the dotted line in fig. 3 b. The inside of this fold is lined with apparently actively secreting cells. Fig. 3 d is a section across just above the elbows of the chelæ and shows the structure of this part of the diverticulum and also that of the lower part of the appendix and the chelicerae. The secretion from these cells at the upper end of the diverticulum is probably for the most part absorbed by the mouth, there being nothing in the structure of the chelæ to indicate absorption as one of their functions. Secretion by the top of the diverticulum is, I think, a somewhat primitive mode among these katoikogenic forms, as it is only continuing to a somewhat later stage the mode by which the embryo is nourished in its early stages before the mouth is formed. The arrangement of the chelicerae leads towards the state of affairs we find in *Ischnurus*, while the method adopted by *Hormurus* derives itself from the secreting upper part of the diverticulum.

Ischnurus ochropus, Koch. (Pl. IX. figs. 4 a-e.)

The embryos of *Ischnurus* are in an advanced stage and measure 10 millim. in length, while the appendix at the distal end of the follicle measures about 3 millim. The form of the appendix differs from that of *Scorpio* in that it is not spirally twisted on itself and has a distinct dilatation on it. On removing the follicle, which can be done without much difficulty, the first point that strikes one is the hairiness of the embryo. The segments behind the carapace, which are

cylindrical in shape, are liberally sprinkled with dark yellow curved bristles; these bristles are not simple, but have three or four small protuberances near the base (fig. 4 *e*). When we come to examine the front end of the embryo we find that the chelicerae are inserted wide apart under the angles of the carapace, and lie sloping towards one another in an almost transverse position (fig. 4 *b*). From the end of each there runs a thin process, and these two processes lying close together in the middle line pass forward into the appendix, lying dorsal to the central cord. On tracing one of these processes forward in a series of sections, for I have not been able to dissect out the whole of their course, we find it runs as a simple process till it comes to the dilated part of the appendix. On reaching that, however (fig. 4 *d*), it expands and bifurcates, forming a pair of somewhat irregular plates, which come into close relation with an oval mass of cells. It is beyond question, I think, that these processes must serve to absorb nutritive material from the surrounding cells. It was impossible to make out any details of the histology of these organs beyond the fact that each plate is formed of a thin outer cuticle, lined by a layer of flattened cells with large spherical nuclei. In the middle there seems to be a space filled with granular material, which may be coagulum.

The central cord is thick in the upper part of the appendix, but becomes very small as it runs down towards the embryo. It ends some little way in front of the body of the embryo and is not grasped and masticated by the chelicerae, as in *Scorpio*. There is no special development of secreting cells round the upper end of the diverticulum, such as we find in *Urodacus*.

Opisthocentrus madagascariensis (Kraep.).

This form is practically the same as *Ischnurus*. The chelicerae are continued forwards on each side of the central cord into the appendix; they do not, however, run so far up as in *Ischnurus*, and the continuations are simple instead of being divided up. These two differences, however, are very possibly due to the embryo being considerably younger. The front of the cephalothorax projects forward a considerable distance beyond the mouth, and may be partly absorptive in function. The central cord is coiled in the thick part of the appendix and runs back ventral to the chelicerae as far as the mouth.

Hormurus australasiæ (Fabr.). (Pl. IX. figs. 5 a, b.)

This form was represented among my specimens by some moderately advanced embryos. The appendages are quite distinct, but the eyes have not yet appeared. The diverticula measure about 4 millim. in length and are peculiar in having only a rudimentary appendix. The mode of nutrition is quite peculiar. The chelicerae are short and in no respect unusual in form, while the chelae are unusually large. The last joint of the chelae runs forward close to the middle line and becomes associated with a mass of large granular cells, which look more like young ova than anything else (fig. 5 b, sc.). The association is very close, as the chela is drawn out into processes which run in among the cells. These cells occupy a pocket on the ventral side of the top of the diverticulum; they differ from the secreting cells which occupy a somewhat similar position in *Urodacus* in structure and in being confined to the ventral side, instead of extending as a collar all round. There is a dorsal pocket (fig. 5 b, sc'), also apparently lined by secreting cells, which are more like those of *Urodacus*, but there seem to be no special absorptive organs connected with it.

Palamnæus Thorellii, Poc. (Pl. IX. fig. 6.)

This form agrees more closely with *Scorpio* and *Opisthophthalmus* than with any of the others which I have examined. The free segments grow out into dorsal processes, which in the not very advanced stage in my possession are small, but probably increase in size from this stage on. The chelicerae are in the form of a pair of enormous conical structures, the internal face of each being flattened and longitudinally grooved. The grooves are lined with chitin, and in the tube formed by the apposition of the grooves lies the central cord of the appendix, which is masticated by the chelicerae. The enormous size of these appendages is the most striking feature of these embryos, and suggests that a mode of nourishment like that in *Urodacus* was the earlier arrangement, and that this chewing of the central cord is derived from it, *Palamnæus* being in this case an intermediate form between *Urodacus* and *Scorpio*, in which last the chelicerae are much smaller and more purely masticatory.

If, now, we try to apply the above observations to the classification of the order the result is as follows. I take as a

basis Pocock's classification *. I have enclosed in parentheses the names of those genera which I have not had an opportunity of examining, and their position is in some cases doubtful. So far as observation has gone the members of the family Scorpionidæ are all characterized by the katoikogenic mode of development, the other families—Iuridæ, Bothriuridæ, and Buthidæ—being apoikogenic.

Fam. I. Scorpionidæ.

Subfam. 1. SCORPIONINI.

Scorpio, (*Heterometrus*), (*Microphonus*), (*Ecopetrus*), *Opisthophthalmus*, *Palamnæus*.

In this subfamily the chelicerae masticate the central cord and there are dorso-lateral outgrowths from the free segments. The lung-book lamellæ have spiny free margins. *Opisthophthalmus* might be erected into a separate subfamily on the strength of the extraordinary outgrowths from the carapace and prostomium. *Scorpio*, however, shows an approach to the prostomial outgrowth.

Subfam. 2. ISCHNURINI.

Ischnurus, (*Opisthacanthus*), *Opisthocentrus*, (*Cheloctonus*), (*Chiromachus*).

In this subfamily the chelicerae send root-like processes forward into the appendix, as described above. The lung-books are spinous. This is Pocock's subfamily minus *Hormurus* and *Iomachus*, along with which some of the other genera ought possibly to go.

Subfam. 3. HORMURINI, nov.

Hormurus, (*Iomachus*).

The characteristic feature here is the absorption of nourishment by the chelæ, as described above. The lung-books are spinous. *Iomachus* seems, from Pocock's description, more closely allied to *Hormurus* than to the Ischnurine series.

Subfam. 4. DIPLOCENTRINI, Pocock.

Diplocentrus, (*Oiclus*), *Nebo*, (*Cyphocentrus*).

Nothing is known in this subfamily of the later embryonic

* Ann. & Mag. Nat. Hist. ser. 6, vol. xii. Kraepelin's arrangement (Hamb. Wiss. Anst. 1890 and 1893), which is later, is almost identical as regards the main groups.

stages, and the ovary has been seen only in *Diplocentrus*. The edges of the lung-book lamellæ have an arcade structure in *Diplocentrus* and *Nebo*.

Subfam. 5. *HEMISCORPINI*, Pocock.

Hemiscorpius.

Here also only the ovary is known. The lung-book lamellæ are spinous. I leave the subfamily because there is no evidence to justify me in altering it, though Kraepelin places the one genus among the *Ischnurini*.

Subfam. 6. *URODACINI*, Pocock.

Urodacus, (*Iodacus*), (*Ioctonus*).

The chelicerae form a channel for the secretions of the appendix, and there are also secreting cells round the top of the diverticulum. The lung-book lamellæ are spinous.

The above observations all agree with Pocock's family *Scorpionidæ*, and consequently tend to support his view as to the importance of the pedal spur as a systematic character.

The alterations above are comparatively slight, only one new subfamily being constituted. Further knowledge would, however, probably lead to other minor alterations.

The remaining forms seem all to be apoikogenic. Pocock's *Iuridæ* seem to require a great deal of alteration, the other two families remaining almost as they are in his classification. The following is what I would suggest as a provisional arrangement:—

Fam. II. *Iuridæ* = Subfam. *Iurini*, Pocock,
Vejovini, Kraepelin.

The character I depend on here is the apoikogenic development combined with the small size and comparative or absolute absence of yolk in the egg.

Subfam. 1. *IURINI* = *Iurini*, Thor., + *Caraboctonus*.

Iurus, (*Uroctonus*), *Caraboctonus*.

This subfamily is characterized by the arcade structure of the free edges of the lung-book lamellæ. I have not seen the ovary of *Caraboctonus*.

Subfam. 2. *VEJOVINI* = *Vejovoidæ*, Thor., + *Scorpiops*,
Anuroctonus, and *Hadruroides*.

Vejovis, *Scorpiops*, *Anuroctonus*, *Hadrurus*, (*Hadruroides*).

The lung-book lamellæ in this subfamily are spinous along the margin. The ovaries of *Anuroctonus* and *Hadrurus* have not been seen.

Fam. III. *Chactidæ* = *Chactini*, Poc.

Apoikogenic forms with large yolky egg.

Subfam. 1. *EUSCORPIINI*.

Euscorpius.

Arcade structure of lung-book lamellæ.

Subfam. 2. *CHACTINI* = *Chactini*, Pocock, — *Euscorpius*.

(*Chactas*), (*Hadrurochactas*), (*Heterochactas*), (*Teuthraustes*), *Broteochactas*, *Broteas*.

Spinous margin to lung-book lamellæ.

It is quite possible, though I do not think very probable, that further light on the development may tend to associate the *Euscorpiini* and *Iurini* as against the *Chactini* and *Vejovini*. This would seem to be making the structure of the lung-books of greater importance in this case than the mode of development.

Fam. IV. *Bothriuridæ*, Sim.

Bothriurus, (*Brachistosternus*), (*Mecocentrus*), *Cercophonius*, (*Timogenes*), (*Thestylus*), (*Urophonius*), (*Phonicercus*), (*Centromachus*).

I have only seen the ovary of *Bothriurus* and the lung-books of that species and *Cercophonius*. The eggs are large and spherical and the lung-books spinous.

I have some doubts as to whether this family and the *Chactini* ought not to be united. The shape of the sternum seems not to be so reliable a test of affinity as used to be supposed.

Fam. V. **Buthidæ**=Buthidæ, Sim., + *Chærilus*.

This family is characterized by a yolky egg, apoikogenic development, and the reticulate type of lung-book lamellæ.

Subfam. 1. *CHÆRILINI*.*Chærilus*.

Of this very peculiar genus I have only seen the lung-books, and it is with some misgivings that I place it here on account of their structure.

Subfam. 2. *BUTHINI*=Buthidæ, Sim.

(*Prionurus*), *Buthus*, *Parabuthus*, (*Grosphus*), *Butheolus*, (*Archisometrus*), (*Isometroides*), *Uroplectes*, (*Tityobuthus*), (*Pseudobuthus*), *Isometrus*, *Tityus*, *Centrurus*, (*Heteroctenus*), (*Ananteris*), (*Charmus*), *Heterocharmus*, (*Stenochirus*).

Looked at from the point of view of the evolution of the order there is little doubt but that the apoikogenic type of development is the most primitive. It is only one step from the laying of the eggs, which is the almost universal custom among Arthropoda. *Peripatus*, *Galeodes*, some Diptera, and some of the mites form exceptions to this habit, but in some of them the internal development is evidently secondary. Further, the eggs containing a considerable amount of yolk are probably nearer the primitive type than those in which the yolk is absent. This, indeed, is necessarily so if the laying of the eggs was the primitive habit. This makes the Chactidæ, Bothriuridæ, and Buthidæ the more primitive forms in these respects.

With regard to the structure of the lung-books, I am inclined to consider the "spinous" type as the original. The reticulate type is more complicated, having pillars over part of its surface and a network of ridges over the rest. The "arcade" margin must have arisen from the "spinous" in two or three separate sections, as it seems impossible to connect *Euscorpius*, *Iurus*, and *Diplocentrus* genetically to the exclusion of the other forms. In this case we are left with probably the Chactini as our starting-point, the highly modified sternum seeming to exclude the Bothriuridæ. From this would diverge four lines of descent—Buthidæ, Bothriuridæ, *Euscorpius*, and *Iuridæ*. The *Iuridæ*, of which the *Vejovini* are the more primitive, lead to the katoikogenic

Scorpionidæ. More evidence is wanted before we can judge of the true relation of the various subfamilies of the Scorpionidæ to each other; but of those I have examined I am inclined to place the Urodacini as the lowest. The secretion of nutritious material by a large section of the diverticulum is what one would expect as the earlier form*. Distinctly divergent lines from this point are shown by the Diplocentrini, Hornmurini, Ischnurini, and Scorpionini. Further material is still wanted before many of the forms can be placed, and I have perhaps tried to base too much on a comparatively small number of observations. Doubtless the criticism of other workers in the group will soon correct any points in which I have erred.

EXPLANATION OF PLATE IX.

Lettering throughout.

- | | |
|----------------|---------------------------------|
| i. Chelicerae. | iii.-vi. The walking-legs. |
| ii. Chelæ. | c. c. Central cord of appendix. |

Fig. 1. Iurus. Transverse section of ovarian tube and egg, $\times \frac{50}{1}$.

Fig. 2. Hemiscorpius. A diverticulum with unfertilized egg, $\times \frac{10}{1}$.

Fig. 3. Urodacus.

3 a. Portion of ovarian tube with diverticulum containing embryo, $\times \frac{2}{1}$.

3 b. Dorsal view of carapace and anterior appendages, $\times \frac{10}{1}$. The dotted line shows the way the walls of the appendix are folded.

3 c. Ventral view of the same.

3 d. Transverse section through top of diverticulum and lower part of appendix, $\times \frac{45}{1}$.

Fig. 4. Ischnurus.

4 a. Portion of ovarian tube and diverticulum containing embryo, $\times \frac{2}{1}$.

4 b. Dorsal view of embryo. The forward continuations of the chelicerae are broken short. $\times \frac{10}{1}$.

4 c. One of the chelicerae, $\times \frac{30}{1}$.

4 d. Section through appendix showing continuation forward of the chelicerae (i.). The appendix, being curved, is cut in two

* Is it possible that the loss of yolk was an adaptation to a climate with short summer and long winter, the provision of nourishment for the embryo being thrown on the period when food was abundant instead of yolk eggs being formed during hibernation?

places, one transverse and the other somewhat oblique.

$$\times \frac{50}{1}.$$

4 e. One of the bristles of the embryo, highly magnified.

Fig. 5. *Hormurus australasie*.

5 a. Ventral view of anterior part of embryo. The chelicerae are concealed by the large chelæ. $\times \frac{30}{1}$.

5 b. Transverse section through distal part of chelæ and the secreting cells (sc) surrounding them. sc', dorsal secreting cells.

$$\times \frac{125}{1}.$$

Fig. 6. *Palamnæus Thorellii*. Dorsal view of embryo $\times \frac{10}{1}$.

XVIII.—On the *Synascidia* of the Genus *Colella* and the Polymorphism of their Buds. By M. MAURICE CAULLERY*.

THE genus *Colella*, created by Herdmann for the *Synascidia* collected by the 'Challenger' expedition, belongs to the family of the Distomidæ, and is very nearly related to *Distaplia*.

Among the compound Ascidians in the Museum, the study of which has been entrusted to me by M. Edm. Perrier, there are a certain number of representatives of this genus, some of them from Australia ('Astrolabe' expedition), others from Cape Horn. Thanks to this material, I have been able to obtain a certain number of facts connected with the anatomy, relationships, and blastogenesis of these animals, which I shall set out later in detail. Here I shall only point out the following:—

(1) The species which I have had under examination present all four rows of pores. A specially characteristic arrangement is to be noticed: the second and the third row separate one from the other in the portion near to the endostyle in such a manner as to leave between them a triangular space, not perforated by pores. The pores are not divided into two halves by a transverse band, as in the *Distaplia*. These two characters appear to me to be very suitable as a definition of the genus *Colella*.

(2) The examples of Corms which I have examined are unisexual, a fact already determined by Herdmann for several species; further, in a female Corm the buds only present ovules, in a male Corm only spermatoc vesicles; so that, so far as the material at my disposal would allow me to do so, I conclude that there is for each Corm a defined sexuality,

* From the 'Comptes Rendus,' tome cxxii. 1896, pp. 1066-1069.

persistent at least during a certain number of blastogenetic generations, as I have already noticed in *Distaplia magnilarva*.

(3) The facts observed lead me to consider the origin of the buds as identical with that described by Kovalewsky, Della Valle, and Salensky in *Distaplia*. I have seen nothing which can allow one to admit a budding at the expense of the inferior ectodermic prolongation of individuals, as Herdmann believed to be the case.

But I wish to insist especially upon a curious peculiarity of the buds in a group of species. They are those in which the Corm is composed of a more or less globular head, borne upon a long peduncle, in such a way that the whole reminds one somewhat of a mushroom.

On studying the peduncle it is seen that at the periphery the cell-structure of the tunic is compact and resistant, whilst in the central region it is composed of large vesicular cells, so common in other Tunicata. It is this central region which contains the buds, often packed in great numbers and pressed one against the other. It would appear that, when the evolution of a generation is ended, the globular terminal portion of the Corm where it occurs may be cut off, and that the peduncle regenerates a new head by the development of the buds which it contains. An examination of the buds in different portions of *the same* Corm reveals the following facts:—

(a) In the immediate neighbourhood of the head of the Corm buds are to be found in every stage of development, recalling very much by their structure those of *Distaplia* and containing no reserve material. The external vesicle of these buds is formed by an epithelium, which is very flat and thin. The oldest of these buds penetrate into the head of the Corm.

(b) On the contrary, in the parts of the peduncle distant from the head of the Corm the buds, at the beginning of their development, have the appearance externally of eggs rich in vitellus. On studying them one observes that at the centre a group of cells, deprived of reserve material, is to be found, corresponding with the internal vesicle and the mesenchymatous cells of the buds *a*, and that all the reserve material, the appearance and reaction of which are those of vitellus, is accumulated in the cells of the external vesicle. The relations of size of the central mass and of the ectodermic layer so modified are often those of the germinative vesicle and the entire egg in a compound Ascidian at the moment when the germinative vesicle is most developed. These buds very

probably remain for a very long and variable time before evolution takes place. In the development all the organs are formed at the expense of the internal cells, the ectoderm charged with reserve material being a simple envelope, of which the thickness diminishes gradually.

It would be very interesting to study minutely the organogenesis in these buds *b*, and to compare it with that of the buds *a*. I have not been able to carry it out so fully as I desired, the presence of the vitellus rendering it difficult to prepare sections of material already stale and not preserved in the special manner required for histological investigation. Nevertheless, from the facts observed I can conclude with all but perfect certainty that the organogenesis is the same in the two cases. Further, there exist between the extreme types of bud transitional forms in which the reserve material is more or less abundant.

This example of the polymorphism of buds appears to me to be very interesting for the following reasons:—

1. It is the property of a special form of Corm; I have not observed it in the species in which the peduncle is not sharply separated from the part which contains the adult ascidiozooids. The buds loaded with reserve material are those which, by their position, do not develop immediately. It appears that they can pass through their various stages by themselves; now it is probable that they regenerate the colony when the head is amputated, and it would be very curious to produce wounds upon these forms in the living state*—to destroy the head, for example, and study the subsequent behaviour of the peduncle. I would also recall the fact that this tendency is analogous to others presented by certain compound Ascidians at the time of hibernation.

2. These facts seem to me to be specially important in the general history of budding in the Ascidians. The external wall of the bud arises always from the ectoderm of the parent, and the internal vesicle is in general of endodermic origin. A study of the blastogenesis shows, however, that it is this internal vesicle which furnishes all the organs of the blastozooid, even those, such as the peribranchial cavity and the nervous system, which, in the oozoid, were ectodermic. The external vesicle is reduced to the rôle of integument. Here we see it charged with reserve material—a remarkable fact, seeing that in general the reserves localize themselves in the endodermic and mesodermic tissues. But this new function

* Unfortunately, so far as at present known, they are confined to the seas south of the Equator.

appears to me to be further in accord with the fact that this tissue has, in the allied forms, lost all organogenetic power, this having passed entirely to the internal vesicle. The accumulation of vitelline reserve in the cells of this wall would be a new step in this modification of the ectodermic layer in the phylogenic series of blastogenesis.

3. This variability in the bud, lastly, recalls, without being identical, the phenomena classed by Giard under the name *pæcilogony*.

XIX.—*Budding in Perophora*. By W. K. BROOKS
and GEORGE LEFEVRE *.

(Abstract of a paper presented to the National Academy of Sciences,
April 23rd, 1896.)

IN the 'Johns Hopkins University Circulars,' no. 119, June 1895 †, the junior author of this paper published a short note on the budding of *Perophora viridis*, Verrill. From a further and more exhaustive study of the subject we have since arrived at fuller and more detailed results than those obtained at that time, and now give in brief a summary of the chief points in the budding of this Ascidian, in anticipation of the complete paper, which will appear shortly.

The material which has been at our disposal was obtained at Beaufort, N. C., and at Woods Holl, Mass., and contained an unlimited supply of buds. The results are based on a study of an uninterrupted series of stages of both serial sections and buds mounted as total preparations.

The buds are formed in a single row on one side of the branching stolons, and always arise in the plane of the stolon double-walled partition, which divides the cavity of the stolon longitudinally into two compartments or sinuses. The latter contain the free cells of the blood and are in open communication at all times with the body-cavities of the buds, so that a free circulation of blood is kept up from the one to the other.

The definitive median sagittal plane of the bud coincides with the plane of the stolon partition, and therefore the latter structure divides the stolon into a right and left half in reference to the parts of the bud.

* From the 'Johns Hopkins University Circulars' for June 1896, pp. 79-81.

† Reprinted in the 'Annals' for 1895, vol. xvi. p. 213.

The first appearance of a bud is announced by the thickening at a given point of the ectodermal wall of the stolon, which becomes slightly raised up into a hemispherical protuberance. The ectodermal cells, which are elsewhere flat and attenuated, are here nearly cuboidal.

By making a cross-section through the stolon at such a place it is found that the walls of the stolon partition are no longer closely pressed together, but are wide apart, and greatly thickened on the side next to the bulged-out ectoderm.

The thickened portion of the partition soon grows out into the ectodermal evagination, and becomes closed off as a vesicle by the coming together of the walls of the partition inside the stolon proper.

This evaginated thickened part of the partition forms the "endodermal vesicle" of the bud-rudiment, and its cavity is to be regarded as being in communication for some time with the potential cavity of the partition, as the connexion with the latter is not lost until a much later stage.

When the protrusion of the bud-rudiment beyond the surface of the stolon has proceeded to a certain extent the ectodermal connexion becomes somewhat constricted, and the rudiment, which has now a spherical form, stands out on the stolon as a round knob. It does not long retain this shape, but soon begins to elongate in the direction of the free tip of the stolon. It is now ellipsoidal in form, with its long axis parallel to the long axis of the stolon, and one end lies free over the surface of the stolon beyond that portion which is directly connected with the latter. It is this free end which is later to be distinguished as the anterior part of the bud, while by the process of elongation anteriorly the connexion with the stolon comes to be left behind in the posterior region. The side next to the stolon wall becomes the ventral surface of the bud and that opposite it the dorsal.

By this time the rudiments of several structures begin to appear. They do not all arise simultaneously, however, and although the pericardium is the earliest to be laid down, it will be necessary to describe the formation of the peribranchial sacs first, in order to render intelligible certain relations between these and other structures.

The Peribranchial Cavity.

The observations on the development of this structure in *Perophora viridis*, although agreeing with those of Hjort* on

* Mitth. Zool. Stat. Neapel, 10 Bd., 1893.

Botryllus in so far as they show that the peribranchial sacs do not arise separately as closed vesicles, which later unite dorsally to form the cloacal cavity, indicate that the process is not so simple as that which occurs in *Botryllus*.

If a transverse section of a young bud be examined at about the time when the elongation spoken of above is just beginning, it will be found that the wall of the inner vesicle is no longer of uniform thickness, but that it is much thicker on the right side than elsewhere. This is the first indication of a marked change which now takes place in the internal relations of the bud.

By a peculiar process, which may be described as a transverse or rotatory growth, affecting the inner vesicle, the thickened right wall is carried or pushed down until it comes to lie on the ventral side, that is, the side next the stolon. The connexion with the stolonian partition remains stationary, and the rotatory shifting of the vesicle takes place on this as a fixed support. The actual right side of the vesicle at the beginning is therefore morphologically the ventral side, as it ultimately forms the floor of the pharynx, and several organs which have a definitive ventral position make their appearance first high up on the right side.

As the displacement of the inner vesicle proceeds the difference in thickness between what was at first nearly the whole right side and the rest of the vesicle becomes more marked. The cells composing the entire vesicle, except in the thicker region, which remains uniform, are seen to be growing more and more flattened. It would therefore seem most probable that this shifting or displacement is brought about by the rapid growth and drawing-out of the cells which make up the greater portion of the wall of the vesicle.

Very soon after this process begins the wall of the vesicle on the ventral side is folded in in such a way as to divide off a part of the vesicle on the left side, which is united to the stolonian partition by the original connexion; this is the *left peribranchial sac*. The fold begins somewhat in front of the middle of the vesicle, and, deepening rapidly in this region, gradually extends posteriorly.

The first indication of the *right peribranchial sac* is a slight longitudinal folding-in of the wall of the inner vesicle some distance up on the right side, and appears after the shifting of the vesicle has begun. As in the case of the left fold, the right one also begins near the middle of the bud, and as it deepens and extends towards the posterior end it is carried down ventrally with the displacement of the vesicle.

As the shifting continues the inner vesicle tends more and

more to assume a symmetrical position. The two longitudinal folds, which grow rapidly and run in obliquely to meet each other, do not come together on the dorsal surface of the vesicle, but some distance below it. The result of this is that, when the right and left peribranchial sacs are separated from the inner vesicle, a median dorsal portion connecting the lateral sacs is cut off at the same time. This median piece, the cloaca, therefore does not arise from the fusion of the lateral sacs dorsally, but the three parts are constricted off together. This is essentially the same process as that which Pizon* and Hjort (*l. c.*) have described for *Botryllus*.

In *Perophora viridis* the folds which separate the peribranchial cavity from the inner vesicle do not involve the entire length of the latter, but leave nearly the whole of the anterior half undivided, as well as a short portion at the posterior end.

When the right and left sacs are being formed, as just described, a broad pouch or diverticulum grows out from the anterior margin of each and gradually spreads over the undivided portion of the inner vesicle. These pouches are merely continuations or extensions of the lateral sacs, and later completely cover the sides of the anterior region of the branchial sac.

Similar prolongations are carried out from the posterior margin of the sacs, and, though not prominent at first, as the bud becomes older and increases in length they attain a considerable size.

According to Pizon (*l. c.*) in *Botryllus* the inner vesicle gives off two posterior lateral diverticula, which are cut off together with the peribranchial cavity, and then appear as posterior prolongations of the latter, with which they always remain in communication. They are what Pizon calls the "*diverticules périviscéraux*," and from the fact that they arise as diverticula from the posterior end of the inner vesicle, he regards them as homologous with the epicardial sacs of some other Ascidians. If this relationship is true, the connexion of the "epicardial sacs" in *Botryllus* with the peribranchial cavity is probably the result of the early separation of the latter from the inner vesicle.

In the light of these considerations it is possible, then, that the posterior extensions of the peribranchial sacs in *Perophora viridis* have the same significance; but it is to be borne in mind, however, that if such be the case, their direct origin from the inner vesicle has been lost completely, as they do

* Ann. Sc. Nat., Zool. (7) t. xiv., 1893.

not appear until a very late stage, and then merely as prolongations backward of the peribranchial cavity, after the latter has been entirely severed from the inner vesicle. This would therefore be a still more modified condition than that which occurs in *Botryllus*.

Pizon makes the statement that in the buds of *Perophora Listeri* he has found that epicardial tubes arise as two diverticula from the posterior end of the branchial sac, in the same manner as has been described for *Amaroncium*, *Clavelina*, &c. Such an account is not in the slightest accord with our observations, and if epicardial tubes arise in this manner in the buds of the European species, they certainly do not in *Perophora viridis*.

The Branchial Sac.

That portion of the primitive inner vesicle which is left after the separation of the peribranchial cavity becomes the branchial sac or pharynx. The thickened right wall of the vesicle, as already stated, is shifted or pushed down until it comes to lie on the ventral side, where it forms the floor of the future pharynx.

Very soon after the vesicle has begun to change its position a slight longitudinal groove is found on the inner surface of the vesicle high up on the right side. It runs through the middle of the thickened area—that is to say, above and below it there are equal portions of the thick wall, which will lie on its right and left, when by the displacement of the vesicle the groove is brought down to the mid-ventral line. By the deepening and widening of this groove and by the differentiation of the cells bordering upon it the definitive *endostyle* is formed.

After the appearance of the gill-slits, each of which arises as an independent formation, the pharynx is put into communication with the peribranchial cavity.

The ectoderm of the bud becomes greatly thickened at a point opposite the extreme anterior end of the branchial sac, and invaginates until it touches the wall of the latter. A complete fusion then takes place, an opening breaks through, and the branchial orifice is established.

The cloacal orifice is formed in exactly the same way, by the union of an ectodermal invagination with the wall of the cloaca at the anterior end of the latter.

The Digestive Tract.

Some time before the displacement of the inner vesicle is

completed, and when the folds which will cut off the peribranchial cavity are not very deep, the wall of the inner vesicle far up on the left side at the extreme posterior end becomes much thickened, and at once evaginates to produce a little blind pouch, the rudiment of the *digestive tract*. This lateral diverticulum grows out as a tube, which bends sharply downward and forward, while through the displacement of the vesicle its proximal end is carried up to the mid-dorsal line.

The tube very soon turns abruptly on itself to form a U, and, now growing upward along the outer wall of the left peribranchial sac until it reaches the dorsal surface, it there bends directly forward, and stops short at the posterior wall of the cloaca. Here a fusion takes place, and an opening breaks through to form the anus.

The differentiation into œsophagus, stomach, and intestine is apparent at quite an early stage, and the whole tract, which lies entirely on the left side of the bud, later becomes closely enveloped by the outer wall of the peribranchial cavity.

The "pyloric gland," or "*organe réfringent*" of Giard, arises as a tubular diverticulum from the anterior wall of the stomach, and produces a dichotomously branching system of tubules, which form a lacework closely surrounding the intestine. Each tubule terminates in a little vesicle or ampulla, whose walls are made up of very flat cells containing deeply staining nuclei.

There is nothing in the structure of this organ to suggest a glandular nature, but, as Pizon (*l. c.*) supposes, its function is probably to absorb the products of digestion.

The Pericardium and Heart.

In sections of very young buds it is seen that many isolated cells of a mesodermal appearance and exactly like the free amoeboid cells of the blood are lying at numerous points against the outer surface of the endoderm and inner surface of the ectoderm.

When the difference in thickness between the right side and the rest of the inner vesicle is becoming apparent, a marked tendency in these scattered cells to accumulate in one spot is noticed. At first there is but a single layer of cells joined loosely end to end, and forming an elongated patch adhering to the outer wall of the inner vesicle high up on the right side in the posterior end of the bud. This is the rudiment of the *pericardium*, which is the first organ to make its appearance.

There is no reason for believing that these cells are not true mesodermal cells, for in the early stages of development the similarity between many of the free cells of the blood and those which make up this mass is perfectly apparent. There is certainly not the slightest evidence that the wall of the inner vesicle evaginates or its cells proliferate at this point, the line of demarcation between the two structures being distinct and unbroken throughout.

With the displacement of the vesicle the rudiment, which is firmly attached to the wall of the latter, is passively carried down to the ventral side; but long before it has reached its definitive position it has become thicker and more compact, and a cavity has appeared in its centre, around which the cells arrange themselves into a one-layered epithelium to form an elongated closed sac.

When the change in position of the vesicle is completed the pericardial sac loses its attachment to the wall, and a longitudinal folding-in of the dorsal side takes place in the usual way to form the heart.

The Dorsal Tube and Ganglion.

Very soon after the cells which make up the rudiment of the pericardium have made their appearance a similar collection of cells is found on the outer surface of the inner vesicle somewhat to the left of the median dorsal line in the anterior end of the bud. These cells, which are at first very loosely grouped together, form an irregular elongated mass, the rudiment of the *dorsal tube*; and so gradual is the transition from the surrounding cells of the blood to those of the rudiment, that at this early stage it is impossible to say where the former end and the latter begin.

As in the case of the pericardium, there is every reason to believe that the dorsal tube is likewise formed of true mesodermal cells. The line of separation between the rudiment and the wall of the vesicle is perfectly distinct and clearly marked, and there is no evidence whatever of proliferation of endodermal cells at any point, while during the early stages the cells which are to give rise to the tube and the free amœboid cells of the blood are identical in size and appearance.

The rudiment gradually increases in size, and the cells composing it become closely packed together to form a solid elongated mass, firmly adhering to the wall of the vesicle. A lumen appears in the centre, around which the cells arrange

themselves into an epithelium, and the structure has now the form of a long tube closed at both ends.

By this time the tube has been carried up to the dorsal mid-line by the shifting of the inner vesicle, and later its anterior extremity fuses with the dorsal wall of the branchial sac, whereupon an opening breaks through to put the lumen of the tube in communication with the branchial cavity.

In the preliminary note, referred to at the beginning of this article, the statement was made that "the ganglion is formed by a thickening of the dorsal wall of the tube, which eventually becomes constricted off." More careful study of very young stages has shown that this is not a correct description of the formation of the ganglion.

About the time that the dorsal tube acquires its opening into the pharynx a few cells, identical in appearance with the mesodermal cells, are found adhering to the dorsal surface of the tube along nearly the whole length of the latter. It is a difficult question to decide whether these cells are mesodermal, as their appearance indicates, or whether they are wandering cells from the wall of the tube, for in many places the border of the latter is broken, and there is a decided indication of migration of cells into the rudiment. On the other hand, it is perfectly evident, especially in later stages, that free amœboid cells are added to the mass from without. The conclusion has therefore been drawn that the ganglion has a double origin and that both the dorsal wall of the tube and free mesodermal cells co-operate in forming it.

The rudiment increases enormously in size, the cell-boundaries are completely lost, and the nuclei arrange themselves peripherally into two or three layers around a central core in which fine fibrils are afterwards laid down. The definitive structure of the ganglion is then attained.

The Sexual Organs.

Our observations on the development of these organs closely agree with the description given by Van Beneden and Julin* for the buds of *Perophora Listeri*.

Shortly after the peribranchial cavity has been completely separated from the branchial sac a small collection of mesodermal cells is found lying in front of the wall of the stomach almost at the point where the latter is connected with the duct of the "organe réfringent." A cavity soon appears in

* Arch. de Biologie, t. vi., 1887.

the centre of the mass, which now assumes a spherical shape, and becomes connected with a solid string of mesodermal cells, the genital cord, running parallel to the intestine and extending all the way to the posterior wall of the cloaca.

As the Belgian authors have shown, from this simple sphere and single cord of cells, testis, ovary, vas deferens, and oviduct are all differentiated later.

XX.—*On a Collection of Land-Shells from the Islands of Selayar, Jampea, and Kalao.* By EDGAR A. SMITH, F.Z.S., Assistant-Keeper of Zoology, British Museum.

[Plate X.]

THE collection about to be described was made by Mr. A. Everett at the end of last year. It contains several new and interesting species. Already nine species of land Mollusca have been quoted from Selayar, but none appear to have been recorded from either Jampea or Kalao. These islands are situated to the south of the large island of Celebes, Selayar being nearest to it and the others nearly midway between it and Flores.

Some of the species occur on all three of the islands, some on two only, and a few are common to Celebes and Selayar.

Four have as yet been met with only on Selayar, three on Jampea, and five on Kalao. Further investigation may show that some of these are not so restricted in their distribution.

The species recorded from Selayar by E. von Martens * which are not in the present collection are *Macrochlamys minuta*, *Amphidromus sultanus* (= *perversa*, var.), *Stenogyra achatinacea*, and *Vaginulus viviparus*.

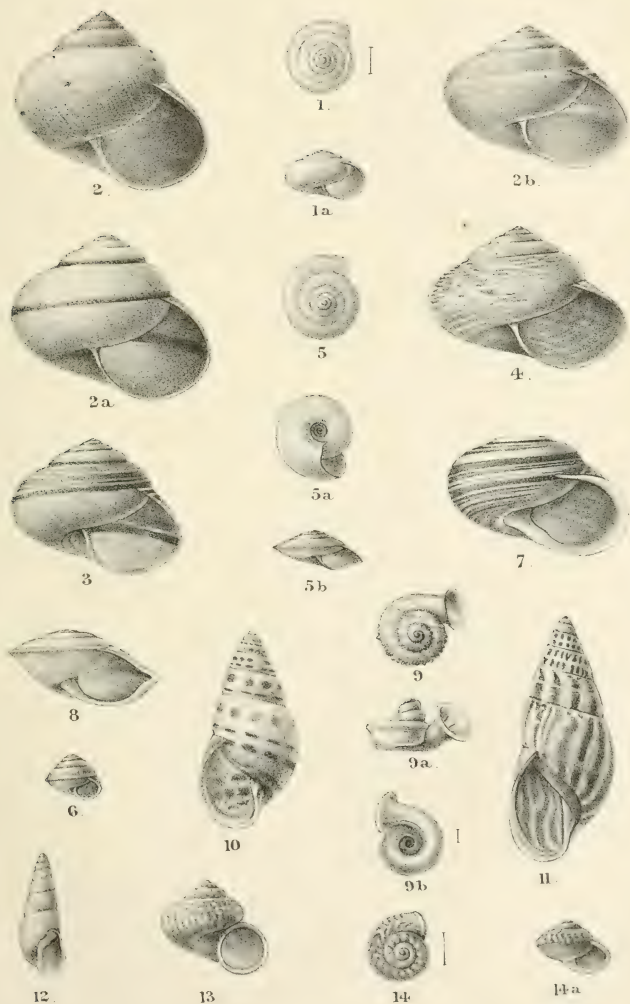
Microcystina consueta. (Pl. X. figs. 1, 1 a.)

Testa orbicularis, depressa, perforata, pellucida, polita; spira brevissime conica; anfractus 5-6, convexiusculi, lente accrescentes, infra suturam anguste marginati, ultimus antice haud descendens, ad peripheriam rotundatus; apertura oblique lunata; peristoma tenue, ad insertionem leviter reflexum, supra umbilicum linguatim subproductum.

Diam. maj. $4\frac{1}{4}$ millim., min. fere 4, alt. 2.

Hab. Selayar, Jampea, and Kalao Islands.

* Max Weber's Zool. Ergeb. vol. ii. pp. 231, 240, 243, 246.



J. Green del et lith.

Mintern Bros. imp.

LAND SHELLS FROM SELAYAR, JAMPEA & KALAO IS.

Smaller than *Macrochlamys indifferens*, Smith, from South Celebes, but consisting of an additional whorl, and of a paler colour.

Macrochlamys minuta, Martens, from Selayar is a closely allied form.

Kaliella indifferens, Boettger.

Kaliella indifferens, Boettger, Bericht Senck. nat. Gesell. 1891, p. 256, pl. iii. figs. 4-4 b.

Hab. Amboina and Saparua (*Boettger*); Java (*in Brit. Mus., fide G. B. Sowerby*); Kalao (*Everett*).

The specimens from Java were obtained from Mr. Sowerby, who doubtless received them with this locality and the above name. They agree precisely with the examples from Kalao.

Xesta fulvizona, Martens. (Pl. X. figs. 2-2 b.)

Nanina fulvizona, Mousson, MSS., Martens, Preuss. Exped. Ost-Asien, Zool. vol. ii. p. 201; Pfeiffer, Novitat. Conch. vol. iv. p. 28, pl. cxv. figs. 6-10; Martens, in Max Weber's Zool. Ergeb. vol. ii. p. 228, pl. xiii. fig. 16.

Hab. South Celebes (*Martens and Wallace*); Saleyer Island (*Martens and Everett*).

This species is excessively variable not only in colour, as pointed out by Martens, but also with regard to the texture of the shell. Some of the specimens collected by Mr. Everett are quite thin and transparent (var. *tenuis*, mihi, fig. 2 b), and one could hardly believe that they belonged to the same species as the strong solid shells found along with them on the same island if there were no connecting-links or intermediate forms to judge by. The series at hand, however, seems to point to the conclusion that they really are nothing more than a variety, which probably was found either at a different elevation or living under somewhat different conditions to the stouter forms. I could add several colour-varieties to those already described, but without the aid of coloured figures it is difficult to convey to others the differences of the various shades of colour.

Xesta selayarensis. (Pl. X. fig. 3.)

Testa perforata, depresso turbinata, albida, ad peripheriam et suturam saturate fusco zonata, supra medium anfractus ultimi pallide fusco spiraliter lineata, infra lineis paucis concentricis interdum ornata; anfractus 6, convexiusculi, regulariter et lente crescentes striis incrementi obliquis tenuibus aliisque spiralibus tenuioribus sculpti, ultimus in medio rotundatus vix descendens; apertura

late lunata, concolor, in medio zonata et supra lineata; peristoma tenue, margine columellari breviter expanso et reflexo.

Diam. maj. 28 millim., min. $24\frac{1}{2}$, alt. 21.

Hab. Bauluan Islet, Selayar group.

Allied to *X. nemorensis*, but spire less elevated, lines of growth finer, and colour different. The fine spiral brown lineation is peculiar and the suture is bordered beneath with a fine blackish line. The coloration is not unlike that of *Xesta Stuartiæ*, but the form is more depressed and the sculpture finer.

Xesta kalaoensis. (Pl. X. fig. 4.)

Testa perforata, depresso turbinata, mediocriter tenuis, cinereo-fusca, punctis pellucidis irregulariter picta, inferne lineis concentricis albidis plus minus distinctis ornata, vix nitida; anfractus 6, convexiusculi, sublente accrescentes, lineis incrementi tenuibus obliquis arcuatis sculpti, sutura simplice sejuncti, ultimus ad peripheriam rotundatus, antice vix descendens; apertura late et oblique lunata, intus concolor albo lineata; peristoma tenue, margine columellari ad insertionem breviter dilatato et reflexo.

Diam. maj. 33 millim., min. $28\frac{1}{2}$, alt. $22\frac{1}{2}$.

Hab. Kalao Island.

Allied to *X. inquinata* from Java in colour and general appearance, but quite distinct. The whorls are more convex, the last not subcarinate, and the surface is not spirally sculptured.

Trochomorpha jampeana. (Pl. X. figs. 5-5 b.)

Testa orbicularis, carinata, late umbilicata, fusca, haud nitida, lineis incrementi tenuibus sculpta; spira depresso conoidalis, ad apicem obtusa; anfract. 6, lente accrescentes, leviter convexiusculi, supra suturam anguste castaneo carino-marginati, ultimus cæteris minus convexus, acute compresso carinatus, haud descendens; apertura securiformis; peristoma tenue, margine inferiore levissime incrassato.

Diam. maj. 15 millim., min. 14, alt. 5.

Hab. Jampea Island.

Rather like *T. Lamonti*, Brazier, from New Guinea, but less acutely keeled, more narrowly margined at the suture, browner, more opaque, and with slightly more convex whorls. The umbilicus also is deeper and less open. *T. gorontalensis*, Martens, has the periomphalium more angulated and a whorl less in shells of the same size; it is also smoother and rather glossy.

Eulota textoria, Martens.

Helix (Eulotella) textoria, Martens, in Max Weber's Zool. Ergeb. vol. ii. p. 236, pl. xiv. figs. 9-12.

Hab. Selayar, Jampea, and Kalao Islands (*Everett*) ; South Celebes and Saleyer (*Martens*).

The specimens collected by Mr. Everett at Selayar were mostly smaller than those from the other two islands. The largest example from Kalao is nearly 16 millim. in its greatest diameter. The umbilicus in the Selayar specimens is slightly wider than in those from Jampea and Kalao.

Plectotropis crassiuscula. (Pl. X. fig. 6.)

Testa obtuse conica, carinata, umbilicata, fuscescens ; lineis incrementi tenuibus aliisque spiralibus (præcipue supra et infra medium anfr. ultimi) sculpta ; spira convexa, obtusa, elata ; anfractus 6, convexiusculi, lente crescentes, ultimus in medio carinatus, supra et infra carinam concave impressus, subtus convexiusculus, vix descendens ; umbilicus profundus, circiter $\frac{1}{2}$ diam. adæquans ; apertura obliqua, sublunata, parva ; peristoma pallidum, valde incrassatum, vix expansum, marginibus leviter conniventibus, callo tenui junctis.

Diam. maj. 9 millim., min. 8, alt. $7\frac{1}{2}$.

Hab. Kalao Island.

Probably belonging to *Plectotropis*, having the shell-characters as exhibited in *P. Winteriana*, Pfr., from Java &c., only modified, the spire being higher, the umbilicus narrower, and the peristome thicker.

Planispira admirabilis. (Pl. X. fig. 7.)

Testa depresso subglobosa, mediocriter tenuis, albo- et rufo-fusco spiraliter zonata, zona alba paulo supra medium anfractus ultimi præcipue conspicua, semiobtecto umbilicata, epidermide tenuissima plus minus induta, lineis incrementi tenuibus striata ; spira planiuscula, pallida, ad suturam linea nigro-fusca cincta, ad apicem leviter impressa ; anfractus $4\frac{1}{2}$, convexiusculi, celeriter accrescentes, ultimus ad peripheriam rotundatus, antice deflexus ; apertura leviter obliqua, late lunata, coloribus externis translucetibus picta ; peristoma tenue, dilute lilaceum, undique expansum, margine columellari reflexo, ad insertionem paulo dilatato, umbilicum fere obtegente.

Diam. maj. 31 millim., min. 24, alt. 18.

Hab. Jampea Island.

Helicostyla (Corasia) subtenuis. (Pl. X. fig. 8.)

Testa depressa, orbicularis, carinata, anguste umbilicata, alba, infra zonis paucis subpellucidis indistinctis ornata, lineis incrementi sculpta, supra paulo malleata; spira subplana; anfractus $4\frac{1}{2}$, vix convexiusculi, penult. punctatus, ult. ad peripheriam acute carinatus, supra et infra carinam impressus, infra convexus, antice ad labrum vix descendens; apertura securiformis, alba, ad carinam linea opaca alba ornata; peristoma tenue, marginibus distantibus, superiore anguste expanso, inferiore latius reflexo, ad insertionem dilatato, umbilicum semiobtegente.

Diam. maj. 15 millim., min. 20, alt. 12.

Hab. Selayar Island.

A flattened depressed form like *C. reginæ* &c., and peculiar on account of a slight umbilicus.

Hypselostoma Everetti. (Pl. X. figs. 9-9 b.)

Testa minuta, aperte perspective umbilicata, fusca, striis incrementi et spiralibus minute decussata; spira parva, elata; anfractus 4, convexi, sutura profunda discreti, apicales magni, ultimus circa medium concavus, supra et circa umbilicum obtuse angulatus, antice solutus ascendens, aperturam versus scrobiculatus; apertura tubæformis, dentibus pluribus intus armata; peristoma dilute rufescens, tenue, expansum, triangulari-rotundatum.

Diam. maj. 3 millim., min. 2, alt. $1\frac{1}{2}$; apertura 1 lata.

Hab. Kalao Island.

In a natural condition all the shells are covered more or less with agglutinated earth, which produces a rough irregular appearance. There are five principal converging teeth within the aperture, and a few smaller intermediate ones, none reaching to the edge of the labrum.

A species from Java in the British Museum, labelled "*H. Fruhstorferi*, Bttgr.," somewhat resembles the present form; it is, however, larger, has the last whorl less freely produced, is keeled at the middle, and the spire is more elevated.

Amphidromus kalaoensis, Fulton. (Pl. X. fig. 10.)

Amphidromus kalaoensis, Fulton, Ann. & Mag. Nat. Hist. 1896, vol. xviii. p. 102.

Hab. Kalao Island.

The type described by Mr. Fulton is here figured and is in the National Collection.

Amphidromus Annæ, Martens. (Pl. X. fig. 11.)

Amphidromus Annæ, Martens, in Max Weber's Zool. Ergeb. vol. ii. p. 240, pl. xiv. figs. 19-22; Fulton, Ann. & Mag. Nat. Hist. 1896, vol. xvii. p. 87.

Hab. Selayar Island.

Variable in colour; plain yellow, with flesh-coloured apex and rose columellar callus, or obliquely striped with black, the stripes being more or less interrupted. Some specimens are stronger and heavier than the type.

Buliminus selayarensis. (Pl. X. fig. 12.)

Testa elongata, rimata, dilute fuscescens, spiraliter et oblique striata, minute granulata; spira producta, ad apicem obtusa, mammillata; anfractus $7\frac{1}{2}$, leviter convexi, lente accrescentes, sutura paulo obliqua sejuncti, ultimus ad labrum leviter ascendens, infra medium saccatus; apertura oblonga, intus fuscescens, longit. totius $\frac{1}{3}$ adæquans; peristoma albidum, tenue, marginibus conniventibus, fere junctis, dextro vix dilatato, anteriore et columellari latius expansis.

Longit. 20 millim., diam. $6\frac{1}{2}$; apertura 7 longa, 4 lata.

Hab. Selayar Island.

Buliminus (Rhachis) zonulatus, Pfr.

Hab. Kalao Island (Everett); Celebes (Martens).

Four pale yellowish specimens from Kalao differ from the typical form in being without bands, but all have the characteristic blackish nucleus. One example exhibits a trace of a colour-zone upon the middle of the body-whorl; they are similarly minutely spirally striated.

Clausilia simillima, Smith.

Clausilia simillima, Smith, Proc. Malac. Soc. 1896, vol. ii. p. 99, pl. vii. fig. 25.

Var. nov. *lævior*.

Hab. Selayar Island.

This variety differs from the type from South Celebes in being perhaps a trifle less slender, with slightly finer striæ, and with the puckerings at the suture much less pronounced. The aperture also is perhaps a trifle broader.

Leptopoma vitreum, Lesson.

Hab. Selayar, Jampea, and Kalao Islands.

The specimens of this widely distributed species found by Mr. Everett are all pure white, without bands or other colour-markings.

Cyclotus celebensis, Smith.

Cyclotus celebensis, Smith, Proc. Malac. Soc. 1896, vol. ii. pl. vii. figs. 4-6.

Hab. South Celebes and Selayar Island (*Everett*).

Cyclotus vicinus. (Pl. X. fig. 13.)

Testa turbinata, mediocriter umbilicata, lutescens, castaneo flammulata spiraliterque lineata, lineis incrementi obliquis striata, liris obtusis spiralibus paucis subobsoletis in anfr. ultimi instructa; spira elata, ad apicem obtusa; anfractus 5, perconvexi, ultimus antice subdescendens, prope labrum vix expansus; apertura fere circularis; peristoma leviter incrassatum, albidum, subduplex. Diam. maj. 18 millim., min. 15, alt. 15; apertura 7 lata.

Hab. Jampea Island.

Var. Testa paulo latius umbilicata, anfr. ultimo minore, ad aperturam magis expanso.

Hab. Kalao Island.

This species is allied to *C. politus*, Sow., but may be separated on account of the feeble spiral ridges upon the body-whorl, different colour-markings, more convex whorls, deeper suture, and broader umbilicus.

From the variety *C. amboinensis* it differs in colour-markings, spiral ridging, and more elevated spire.

Cyclotus biangulatus, Martens.

Cyclotus biangulatus, Martens, in Max Weber's Zool. Ergeb. vol. ii. p. 214, pl. xii. figs. 5-9.

Hab. Selayar and Kalao Islands.

Some specimens are paler than others, one from Selayar being pale corneous and entirely devoid of brown markings.

Helicina parva, Sowerby.

Hab. Selayar Island (*Everett*); N. Celebes, Batchian, and Halmahera (*Martens*); Batchian (*Bættger*); Zebu, Philippines (*Sowerby*).

With the exception of being a trifle smaller than Philippine examples I cannot discern any differences in the shells from Selayar.

Helicina exserta, Martens.

Helicina exserta, Martens, in Max Weber's Zool. Ergeb. vol. ii. p. 220, pl. xii. figs. 16-19.

Hab. Selayar.

Many of the specimens have agglutinated earth attached.

Var. *major*.

Shell red or yellow, larger than type, with the whorls but very slightly exserted and the carination at the periphery finer.

Hab. Selayar.

Var. *solidior*.

Shell red or yellow, same size as type, but with less exserted whorls; as strongly keeled at the periphery; spire stouter and less concavely elevated; peristome thicker, body-whorl more strongly impressed above and below the keel.

Hab. Kalao.

Some specimens from Jampea are like the latter variety as regards size and form, but they more resemble the var. *major* as regards the keel, which is finer and less defined below by a depression.

Helicina kalaoensis. (Pl. X. figs. 14, 14 a.)

Testa parva, orbiculari-conica, spiraliter lirata, rufa, albo maculata et flammulata; anfractus 4-5, convexiusculi, apicalis lævis, ultimus obtuse carinatus, liris tenuibus spiralibus 4-6 supra medium, infra 7-8 ornatus; apertura obliqua, semilunata; peristoma intus carneum, extus pallidum, valde incrassatum, subduplex; callus basalis in medio rufescens.

Diam. maj. 6 millim., min. 5, alt. $3\frac{1}{2}$.

Var. Testa olivacea, vel flavescens albo maculata et flammulata.

Hab. Kalao Island.

This species is well characterized by its very strong thickened lip and the spiral ridging.

EXPLANATION OF PLATE X.

Figs. 1, 1 a. *Microcystina consueta*.

Figs. 2-2 b. *Xesta fulvizona*.

Fig. 3. *Xesta selayarensis*.

Fig. 4. *Xesta kalaoensis*.

Figs. 5-5 b. *Trochomorpha jampeana*.

Fig. 6. *Plectotropis crassiuscula*.

Fig. 7. *Planispira admirabilis*.

Fig. 8. *Helicostyla* (*Corasia*) *subtemuis*.

Figs. 9-9 b. *Hypselostoma* *Everetti*.

Fig. 10. *Amphidromus kalaoensis*.

Fig. 11. *Amphidromus* *Anne*.

Fig. 12. *Buliminus selayarensis*.

Fig. 13. *Cyclotus vicinus*.

Figs. 14, 14 a. *Helicina kalaoensis*.

XXI.—Description of a new Genus of Elapine Snakes from Woodlark Island, British New Guinea. By G. A. BOULENGER, F.R.S.

TOXICOCALAMUS.

Allied to *Ogmodon*, Peters, and *Glyphodon*, Gthr. Maxillary extending forwards as far as the palatine, with six teeth gradually decreasing in length, the first a "perforated" poison-fang; mandibular teeth gradually decreasing in length. Head small, not distinct from neck; eye very small, with round pupil; nostril pierced between two nasals; no præocular; postfrontal bone absent. Body cylindrical, extremely elongate; scales smooth, without pits, in 17 rows; ventrals rounded. Tail short; subcaudals in two rows.

Toxicocalamus longissimus.

Rostral a little broader than deep, visible from above; internasals half as long as the præfrontals, which are in contact with the second and third upper labials and with the eye; frontal small, slightly broader than the supraocular, once and a half as long as broad, as long as its distance from the end of the snout, much shorter than the parietals; one postocular; temporals 1+2; six upper labials, third and fourth entering the eye; three lower labials in contact with the anterior chin-shields, which are a little longer than the posterior. Scales in 17 rows. Ventrals 299-305; anal divided; subcaudals 30-31. Tail ending in a compressed horny scute, which is keeled above. Grey-brown above, with darker streaks along the scales; sides whitish, each scale with a grey-brown streak; a yellowish bar across the snout; ventrals white, with two grey-brown longitudinal streaks.

Total length 650 millim.; tail 38.

Two specimens were obtained on Woodlark Island by Mr. A. S. Meek.

XXII.—On Freshwater Fishes from Smyrna.

By G. A. BOULENGER, F.R.S.

THE Trustees of the British Museum are indebted to Mr. F. Holmwood, C.B., H.B.M. Consul-General at Smyrna, for a small but interesting collection of fishes made by him in the rivers and streams between the north coast of Smyrna and Troy. Three out of the seven species represented in the collection are undescribed. The known species are:—*Capoeta fratercula*, Heck.; *Leuciscus berak*, Heck.; *Cobitis tænia*, L.; and *Salmo fario*, var. *macrostigma*, A. Dum.* The new species are here described.

Capoeta Holmwoodii.

Depth of body equal to length of head, $4\frac{1}{2}$ to $4\frac{3}{4}$ times in total length. Snout rounded, feebly projecting beyond the mouth, as long as the eye, which is 4 times in length of head; interorbital width $\frac{2}{3}$ length of head, width of mouth $\frac{1}{4}$; no barbel. Dorsal III 8, without osseous ray, originating midway between end of snout and base of caudal. Anal III 9. Pectoral a little shorter than the head, the distance between its extremity and the base of the ventrals about half its length. Caudal forked. Scales 60–64 $\frac{9-10}{10}$; 5 scales between lateral line and base of ventral. Pale olive above, silvery on the sides and below.

Total length 120 millim.

Two specimens.

Barbus lydianus.

Depth of body $3\frac{2}{3}$ to $4\frac{1}{2}$ times in total length, length of head $3\frac{1}{2}$ to 4 times. Snout rounded, feebly prominent, nearly twice as long as the diameter of the eye, which is $4\frac{1}{2}$ to 5 times in length of head; interorbital width $\frac{1}{2}$ length of head; rostral barbel a little shorter than the maxillary barbel, which measures $1\frac{1}{2}$ to $1\frac{3}{4}$ diameter of eye. Dorsal III 7–8; spine strong, $\frac{2}{3}$ length of head; serræ strong, 23–25; origin of dorsal opposite to outer ventral rays, and a little nearer base of caudal than end of snout. Anal II 5. Caudal forked. Scales 43–46 $\frac{7-8}{8-9}$; 4 or 5 scales between lateral line and base of ventral. Pale olive above, silvery beneath; small irregular dark spots may be present on the back and sides.

Total length 140 millim.

Several specimens.

* This form is represented in the British Museum by specimens from Tetuan, Tangiers, Algeria, Mt. Olympus, and Teheran.

Leuciscus smyrnæus.

Section *Squalius*, Heck. Pharyngeal teeth 5.2. Depth of body 3 to $3\frac{1}{2}$ times in total length, length of head $3\frac{1}{2}$ to $3\frac{3}{4}$ times. Mouth oblique; snout $1\frac{1}{2}$ as long as the eye in the adult; eye 4 to 5 times in length of head, interorbital width $2\frac{1}{2}$ to $2\frac{3}{4}$ times. Dorsal II 7, originating just behind the vertical of the ventral and nearly midway between the end of the snout and the extremity of the caudal fin. Pectoral nearly $\frac{2}{3}$ length of head. Anal III 7-8. Caudal forked. Scales $33-35\frac{6}{4}$; 2 scales between lateral line and base of ventral. Dark olive to blackish above, silvery beneath; rays of paired fins and anal bright yellow.

Total length 160 millim.

Several specimens.

XXIII.—Description of a new Siluroid Fish from the Organ Mountains, Brazil. By G. A. BOULENGER, F.R.S.

Trichomycterus Goeldii.

Head much depressed, as long as broad, six times in total length; eye small, midway between end of snout and opercular border, its diameter half interorbital width; upper maxillary barbel reaching the pectoral; gill-membranes narrowly joined to the isthmus, extending forward to below the eyes. Body as deep as broad; caudal peduncle strongly compressed, twice as long as deep. Dorsal with 10 rays, opposite to the space between ventrals and anal, twice as distant from the end of the snout as from the caudal; anal with 7 rays. Pectorals with the outer ray produced, filiform. Ventrals equally distant from the end of the snout and the posterior border of the caudal fin; latter rounded. Yellowish, with ill-defined brown spots above.

Total length 99 millim.

This fish, which is nearest allied to *T. punctatissimus*, Casteln., and *T. Knerii*, Stdr., is found in brooks at Colonia Alpina, in the Province Rio Janeiro, at an altitude of nearly 2600 feet. I am indebted to Dr. E. A. Göldi and his cousin Mr. Andreas Göldi for a set of the fishes of that locality, which appears to produce but six species. These are, in addition to the one described above:—*Heros acaroides*, Hens.; *Hecostomus microps*, Stdr.; *Characidium fasciatum*, Reinh.; *Tetragonopterus fasciatus*, Cuv.; and *Xiphorhamphus hepsetus*, Cuv.

XXIV.—*Descriptions of Two new Species of Oriental Lycænidæ.* By H. GROSE SMITH, B.A., F.E.S., &c.

Pseudonotis florinda.

Male.—*Upperside.* Both wings dark rather shining blue, irrorated with black, and with broad brownish-black costal and outer margins, the veins crossing the blue area also brownish black; the outer edge of the blue area on the posterior wings is indented between the veins.

Underside. Both wings lighter brownish black, crossed from the upper discoidal nervule towards the apex by a common band of greyish white; the band on the anterior wings is narrowest towards the apex and gradually widens to the inner margin; the band on the posterior wings is of nearly uniform width and crosses them in the middle from the costal to the inner margin. On the posterior wings is a submarginal band of large silvery-blue lunules, extending from the second subcostal nervule to the inner margin; these lunules are centred with large contiguous oval black spots, the three spots nearest the anal angle narrower than the others; the tails, which are single, are rather thick.

Expanse of wings $1\frac{1}{2}$ inch.

Hab. Guadalcanar, Solomon Islands (*C. M. Woodford*).

Described from a single specimen.

Myrina milo.

Female.—*Upperside.* Both wings greyish brown, crossed by a common central broad white band extending from the lower discoidal nervule of the anterior to the inner margin of the posterior wings, as in *M. danis*, Felder, but the band is wider on the anterior wings, and on the posterior wings does not extend so far along the costal margin. On the posterior wings is a very narrow, well-defined, submarginal white line, extending nearly to the apex.

Underside with the white band as above, but on the anterior wings it extends nearer to the apex and costal margin, and in the dark marginal area there is a band of narrow blue lunules. On the posterior wings, in the dark marginal area, is a submarginal band of silvery azure-blue lunules, centred with black, those nearest the apex the smallest, gradually increasing in size to the submedian nervure; above the anal angle the lunule with its central spot is the smallest; above the two

lunules nearest the anal angle are several silvery azure-blue spots and lines, crowned by a V-shaped black line, and another black line situated horizontally towards the inner margin. The posterior wings have two tails.

Expanse of wings $1\frac{1}{8}$ inch.

Hab. New Ireland.

Described from a female specimen. There is a male from the same locality, but it is too much rubbed to permit of a satisfactory description; it does not appear, so far as can be seen, to differ from the female, except that the wings are less rounded and the white band on the anterior wings is more sharply angulated at its upper end.

Nearest to *M. danis*, but differs from it in the absence of the lunules on the upperside of the posterior wings of that species, and on the underside in the deeper and brighter colouring of the lunules on the posterior wings, and otherwise as before mentioned. It is also a smaller species.

XXV.—*Phoxocephalus pectinatus*, Walker, or
P. simplex (Bate)?

*To the Editors of the 'Annals and Magazine of
Natural History.'*

GENTLEMEN,—You published in your May number a description by me of *Phoxocephalus pectinatus*, sp. n. On May 4 I received from Mr. J. T. Calman a copy of a paper published by him in the April number of the Trans. Royal Irish Academy, in which he describes the male of the same species, and refers it to *Phoxocephalus simplex* (Bate). While fully appreciating Mr. Calman's laudable desire not to increase unnecessarily the number of species, I regret that I cannot agree with him as to the identity of the species he and I have described with Bate's. In fact, as a comparison of the two columns annexed will show, almost the only points on which they agree and which are not common to the genus are the gnathopods, and even these, to judge from Bate's figures in the Brit. Mus. Cat., are more unequal in *P. simplex* than in *P. pectinatus*. In short, *P. pectinatus* might be referred to *P. kergueleni* (Stebbing), which it closely resembles in the gnathopods, with much greater reason than to *P. simplex*. The eyes in *P. pectinatus* are large and as conspicuously dark

after several years in spirit as when freshly caught, while in Bate's species they were (like *P. Holbölli*) "not appreciable." The relative proportions of the flagellum and secondary appendage in the upper and the general character of the lower antennæ are totally different. I agree with Mr. Calman that Bate's specimen was an immature male; but he has then to account for the fact that while it measured $\frac{3}{10}$ inch, or about 4 millim., in length, an *adult* male of *P. pectinatus* is only 3 millim. long, a difference which is more than confirmed by comparison with the type specimen at the British Museum. Unfortunately this specimen is in such bad condition that a detailed examination is impossible without dissection.

Phoxus simplex, Bate (Cat. of Amphipodous Crustacea, 1862).

Phoxocephalus pectinatus, Walker, female.

Generic Character.

Eyes *not* appreciable.

Eyes in both sexes *large and dark*, retaining their colour in spirit for years.

Specific Characters.

Superior antennæ having the extremity of the *flagellum not reaching* beyond the anterior margin of the cephalon; the flagellum short, *three-jointed*; secondary appendage *longer* than the primary, four-jointed*.

Inferior antennæ *as long again* as the superior; the joints of the peduncle *scarcely distinguishable* from those of the flagellum.

Length of *immature* male 4 mm.

Superior antennæ having the extremity of the *peduncle reaching* to the anterior margin of the cephalon; flagellum *four-jointed*; secondary appendage much *shorter* than the primary, four-jointed.

Inferior antennæ *half as long again* as the superior; the peduncle *quite distinct* from the flagellum.

Length of *adult* male 3 mm.

ALFRED O. WALKER.

Nant y Glyn, Colwyn Bay,
July 1, 1896.

* In the Brit. Sess.-eyed Crust. the secondary appendage is said to be three-jointed, while the "primary" (flagellum) is four-jointed, the former being "nearly as important" as the latter. The figure, however, shows the secondary appendage much shorter; but as in his earlier description Bate seems to have mistaken the appendage for the flagellum, the description is probably more accurate than the figure.

XXVI.—*Descriptions of Two new Species of Lepidoptera collected by Dr. W. J. Ansorge in East Africa.* By EMILY MARY SHARPE.

Fam. Danaidæ.

Amauris Ansorgei, sp. n.

Allied to *A. Ellioti*, Butler, but differs in having the spots on the fore wing white instead of yellow. In this respect it may be compared with *A. lobengula*, Sharpe, but the spots are somewhat differently placed and the basal area of the hind wing is dull argillaceous, with a very broad marginal border and a row of indistinct yellow spots varying in size.

Fore wing. Ground-colour brownish black, with white spots; these spots correspond exactly with *A. Ellioti*, figured in the Proc. Zool. Soc. 1895, p. 723, pl. xlii. fig. 1.

Hind wing. The whole of the basal area dull argillaceous, with a broad marginal border and a submarginal row of testaceous spots, which are rather indistinct and vary in size. The first three spots occur, two between the first and second subcostal nervule, the third between the second subcostal nervule and the radial nervule; between the second and third median nervules is a distinct spot; the other spots are almost obliterated. There are five minute white spots at the extreme edge of the hind margin.

Underside. Similar to *A. Ellioti*, having all the spots white on the fore wing instead of yellow. The submarginal row of spots on the hind wing is entirely white and in pairs on either side of the nervules. A second row of minute white spots follows in pairs between each nervule at the extreme edge of the hind margin. The argillaceous base extends from the middle of the costa along the inner margin to the anal angle.

♂.—*Loc.* Uganda, Dec. 30, 1894.

Expanse 3·1 inches.

Fam. Satyridæ.

Mycalesis Ansorgei, sp. n.

This species is allied to *M. rhanidostroma*, Karsch, and *M. saga*, Butler, on the underside.

Fore wing. Basal area dark velvet-brown; a light ochraceous curved band from the costa crossing the apical portion to the submedian nervure; a small ocellus is distinctly visible

between the second and first discoidal nervules; apex darker brown; a round dark spot or brand close to the cell is marked between the first and the third median nervules.

Hind wing dark velvet-brown, with lighter border on the hind margin.

Underside. Basal area almost black-brown, as in *M. saga*; a broad submarginal border greyish or violet-brown, rather lighter than the basal area, with a strongly marked waved line near the hind margin, which is much lighter.

The fore wing has a light apical patch with two ocelli, the first hardly visible, and a third ocellus between the second and first median nervules. On the marginal border of the hind wing is a row of ocelli varying very much in size and placed between each nervule; the first ocellus below the subcostal nervule, the second and third between the nervules as far as the third median, the fourth almost invisible, the largest ocellus between the second and first median nervules, and two minute ones between the first median nervule and the submedian nervule.

A light transverse band crosses both wings from the costa of the fore wing to the inner margin of the hind wing.

♂.—*Loc.* Mtebe, East Africa, July 12, 1894.

Expanse 2·1 inches.

A complete list of this collection will be published shortly.

XXVII.—*Descriptions of some new Lepidoptera from Nyasaland.* By ARTHUR G. BUTLER, Ph.D., F.L.S., &c.

AMONGST the new species in three series of *Lepidoptera* recently collected for the Museum by Mr. R. Crawshay the following interesting forms may be at once described:—

Planema scalivittata, sp. n.

♂. Nearest to *P. aganice*, having the same form and general coloration, but with entirely different banding, the curious almost sigmoidal band and spot on the primaries being replaced by a short quinquelfid dull white transverse bar from the costal to the median vein beyond the cell, and a notched or subangulated transverse dull white bar, obliquely below which is a small spot nearer to the outer margin, the two spots being separated by the second median branch; the band of the secondaries is narrower and tapers much more

towards the costa than in *P. aganice*, and on the underside it is creamy white, with a sharply defined straight inner edge and a nearly parallel (barely angulated) outer edge, broken by the usual internervular streaks.

Expanse of wings 71 millim.

Kasungu Mountain, 7425 feet alt., Nyika, March 1st, 1896.

The markings of the primaries in this species form an almost rectangular zigzag, which runs obliquely from just beyond the middle of the costal to just below the middle of the outer margin.

Alæna reticulata, sp. n.

♂. Above greyish black; primaries with the costal margin to the middle narrowly ochreous; three spots in the cell, the first two squamose, the basal one elongated, cuneiform, the others subquadrate; a squamose whitish patch below median vein from base to near the middle of the wing; an angular white macular bar, consisting of seven spots, from the costa to the first median branch beyond the cell; traces of discal and submarginal series of small spots, the first five spots and the last of the discal series and the second and three last of the submarginal series being white, and therefore fairly well defined; fringe white, flecked with black: secondaries with ashy hairs over the basal half; a white macular angulated band, consisting of eight spots, beyond the middle, the third and fourth spots large, elongated, and confluent, the dividing vein being white instead of black, the last spot with a grey continuation up the abdominal border; a submarginal series of six squamose white spots: body black, margins of eyes snow-white; collar ferruginous; terminal segments of abdomen banded with ochreous; anus ochreous. Under surface somewhat like that of *A. nyassa*, but mostly cream-coloured and black, the reticulations being much more complete; the primaries with narrower postmedian band and continuous black submarginal line; the secondaries with no complete open central space, the black bars being all connected; palpi, tibiæ, tarsi, and ventral surface of abdomen orange-tawny.

Expanse of wings 36 millim.

♀. Larger and much whiter on both surfaces; the secondaries above white, reticulated with greyish and stained on the external area with creamy; below, the submarginal black line is wanting on the primaries and ill-defined on the secondaries.

Expanse of wings 40 millim.

♂, Kasungu Mountain, 5400 feet alt., Nyika, March 5th, 1896; ♀, Mtambwi Hill, Deep Bay, Jan. 6th, 1896.

Cyclopides perexcellens, sp. n.

Allied to *C. metis*, *quadrisignatus*, &c.; above shining bronze-brown, with greenish reflections; primaries with eight spots of bright golden ochreous, as in the most heavily-marked specimens of *C. quadrisignatus*, and a submarginal series of six dots from costa to first median interspace: secondaries with five or six unequal submarginal squamose greenish-ochreous spots and two short streaks beyond the cell; fringe (of these wings only) golden ochreous: body blackish; head and palpi clothed with golden-brown hair, pterygodes with tawny cupreous hair. Primaries below with the costal margin and a decreasing submarginal series of spots creamy whitish varied with buff; fringe with a broad ochreous central band, otherwise marked as above: secondaries ochreous varied with greenish cream; abdominal area deep brown, with longitudinal interrupted bluish-ash streak; veins and margins black; fringe orange or golden ochreous, as above; a triangular spot at base of subcostal area, a band of five irregularly placed unequal spots crossing the cell obliquely, a discal oblique series of five spots, and a marginal series of seven spots metallic silver: palpi below ochreous; pectus brown, clothed with ochreous hairs; venter with central cream-coloured stripe, bordered with ochreous.

Expanse of wings 33 millim.

Two males, Kasungu Mountain, 7425 feet alt., Nyika, March 5th, 1896.

By far the most beautiful species hitherto described, and utterly unlike any other species in the elegant silver spotting of the under surface.

A pair of a very beautiful Limacodid obtained by Mr. Crawshay I was at first inclined to regard as a variety of *Tæda ætitis*, Wllgr.; a careful comparison of the two has, however, convinced me that they are quite distinct species:—

Tæda prasina, sp. n.

Primaries pea-green, bluish at outer margin; markings silver, edged with golden rust-red: secondaries silky ochreous; antennæ reddish testaceous; thorax sage-green; abdomen deep golden ochraceous. Differs from *Tæda ætitis* in the yellower tint of the primaries and the great extension of the silver markings, the basal patch consisting of six or seven divisions separated by rust-red reticulation; the spot beyond the cell four times larger, its outer half divided by golden

rust reticulation into two spots; the short transverse bar towards external angle continued by a series of decreasing spots almost to apex, and somewhat resembling a reversed cornucopia with eight divisions; secondaries uniformly ochreous, the grey suffusion of *T. atitis* being absent.

Expanse of wings 33–34 millim.

Two males, Luvira River, Nyasa to Tanganyika plateau, December 14th, 1895.

Hibrildes Crawshayi, sp. n.

♀. Allied to *H. norax* of Druce (*Anengya spiritalis* of Karsch *), but much smaller; semitransparent rosy tawny, with slender black veins: primaries with a short black bar across the end of the cell; external border dark grey, dentate-sinuate internally, broad at apex, narrow at external angle; fringe grey, becoming whitish tawny towards external angle; secondaries with a black discocellular dash; external border rather broadly blackish, enclosing six spots of the ground-colour; fringe of outer border grey: head ochreous, antennæ black; thorax blackish, spotted with white and buff; abdomen tawny at base, otherwise blackish, with dorsal and lateral spots grading from buff to cream-colour; anal tuft ochreous. Wings below more glossy than above, but similar; face ochreous; pectus deep brown; legs with a few ochreous hairs; venter brown, bounded by an ochreous stripe and a row of cream-coloured spots.

Expanse of wings 61 millim.

Mwini-uruma's town, Nyika to Tanganyika plateau, December 17th, 1895.

HÆMATORITHRA, gen. nov.

Near to *Omiza*, Walk.; differs in its much broader antennæ, in the straight discocellulars of the primaries, and the smaller secondaries, with the subcostal branches emitted together from the same point.

Type *H. rubrifasciata*.

Hæmatorithra rubrifasciata, sp. n.

Primaries sordid sericeous creamy white, with stramineous costa and outer-marginal fringe; a purplish-black transverse dash from costa at basal two sevenths, continued across the

* Described in a paper on African *Lepidoptera*, containing many new names for old species (Ent. Nachr. 1895, p. 374, pl. iv. fig. 7).

wing as a dull blood-red stripe; a similar (but imperfect) oblique subapical purplish-black dash, followed almost immediately by an oblique inwardly directed arched stripe of red, which runs to inner margin; a black discocellular dash: secondaries straw-yellow, with a black spot on upper discocellular veinlet and a red dash near anal angle: face ochreous; vertex of head and broadly pectinated antennæ black; collar and front of pterygodes stramineous; remainder of pterygodes and thorax sericeous sordid creamy white; abdomen greyer, yellowish at sides. Under surface of all the wings ochreous; primaries with no inner band and the outer band reduced to an oblique dash; black discocellular dash as above: secondaries with a red spot beyond the cell; otherwise as above: body below cream-coloured, the legs partly stramineous; palpi ochreous.

Expanse of wings 33 millim.

♂, Kasitu River, foot of Jakwa Mountain, Henga, west of Lake Nyasa, June 16th, 1895.

XXVIII.—*New Species of Pyralidæ from the Khasia Hills.*

By W. WARREN, M.A., F.E.S.

[Continued from p. 119.]

HALIOTIGRIS, gen. nov.

Fore wings narrow and elongate; costa straight for three fourths, then gradually curved; apex rectangular; hind margin curved, more obliquely in the lower half; anal angle obtuse. Hind wings with both angles and hind margin rounded, the latter slightly bent in middle. Abdomen of male extending far beyond hind wings. Antennæ finely ciliated, the basal joint enlarged. Labial palpi obliquely upturned; second joint thick, third short, bluntly pointed; maxillary palpi absent; tongue developed; ocelli present, pale, with dark rim; vertex of head with rough hairs. Neuration: fore wings with cell half the length of wings; discocellular slightly concave; first median at five sixths, third from lower angle of cell, second just before, lower radial just above, the angle; upper median below the upper angle, last subcostal from it; third and fourth stalked; first and second free. Hind wings with first subcostal anastomosing for some considerable distance with costal; medians and radial as in fore wings.

Type *Haliotigris cometa*, sp. n.

Haliotigris cometa, sp. n.

Fore wings white, iridescent; a velvety black basal line prolonged along inner margin; a black inner line at one sixth, oblique and straight to below median vein, then angled; outer line thick, velvety black, at three fourths, attenuated below middle, running in shortly to beneath the discal spot, then, oblique and angled basewards, to inner margin at two thirds; two large discal spots, subquadrate, erect, not reaching costa, filled up with dull fulvous, the outer one edged with darker; central area below median filled up with fulvous and grey scales; a blackish spot above inner margin beyond first line, edged with pale tawny and followed by two blackish streaks; the fulvous suffusion of median area extends beyond the outer line as far as its elbow; veins beyond outer line finely black; the apical two thirds of the marginal space steel-blue, iridescent, white close to outer line and yellowish along costa; fringe steel-blue for two thirds, then white. Hind wings white; an irregular velvety-black fascia close to base; a curved dark grey wispy shade from the discal spot to middle of hind margin with the veins within it blackish; an oblique grey shade towards apex also with the veins in it blackish; anal angle with the veins slightly tinged with grey; fringe white. Head, face, thorax, and patagia yellow-fulvous; middle of thorax black; abdomen white, its basal segment broadly velvety black; a fine dark dorsal line and thicker lateral lines. Underside white, with all the veins and markings black; the two cell-spots of fore wings also black; a tuft of fulvous yellow hairs from base of fore wings.

Expanse of wings 50 millim.

Two males from the Khasias.

A remarkably beautiful insect.

MARGAROCHROMA, gen. nov.

Fore wings with costa faintly sinuous, slightly incurved in middle and convex on either side, strongly at apex; apex produced, blunt; hind margin strongly oblique, hardly curved. Hind wings triangular, the hind margin hardly curved, the apex prominent, the anal angle rounded off. Abdomen of male with rather large anal tuft; antennæ pubescent, with fine short ciliations; labial palpi long, porrect, decumbent, second joint roughly haired, especially above, third joint acute, nearly as long as second; tongue present; maxillary palpi absent; ocelli invisible; forehead strongly produced below. Neuration: fore wings, cell half the length of wing;

discocellular concave, vertical ; first median at three fourths ; second, third, and lower radial all close together from end of cell ; upper radial from below upper angle ; last subcostal from the angle, rather upcurved at its origin ; first and second subcostals free, the second closely approximated to the stem of the third and fourth.

Type *Margarochroma pictalis*, sp. n.

Margarochroma pictalis, sp. n.

Fore wings white, suffused with burnished golden scales ; first line at one fourth, angled on median and submedian veins, the upper half faint, the lower black, distinct ; second line at about two thirds, distinct, black, running straight towards anal angle, curved from the third median to below the discocellular, there sharply retracted and forming an acute angle outwards, and attaining the inner margin near the first line, with which it is united above inner margin by black scales ; the inner line is preceded and the outer followed by a similar parallel but fainter line ; a black crescent on the discocellular and an elongated blackish-edged spot in the cell before it ; median area at and below the median vein darkened with diffuse scales ; some grey scales towards middle of hind margin ; fringe white beyond a very fine dark basal line. Hind wings with basal three fourths mixed fulvous and grey, with a brighter fulvous spot in the middle of its outer margin edged with dark ; marginal area white, with burnished golden scales and traces of a broken blackish line ; fringe as in fore wings. Head and thorax white ; abdomen whitish, with lustrous scales ; the basal segments variegated with tawny and dark grey scales ; anal tuft black ; palpi and lower half of forehead black. Underside whitish, with the markings and some marginal clouds dark ; basal half of both wings dull blackish.

Expanse of wings 24 millim.

One male from the Khasias.

Genus PLEUROPTYA, Meyr.

Pleuroptya fuscalis, sp. n.

Fore wings fulvous fuscous, darker along costa and hind margin, the lines and spots dark fuscous ; first line near base, vertical in its lower half, recurved basewards above, and indistinct towards costa ; second line at three fourths, diffuse, inwardly oblique at first, then forming a shallow sinus, in-curved below middle and darker below discal spot to inner

margin at two thirds ; marginal space darker fuscous to near second line ; a small dark spot in cell and a larger one at the end ; fringe dark grey. Hind wings paler, more yellowish, with dark discal spot, and exterior line as on fore wings ; marginal space dark fuscous, becoming blackish and somewhat metallic at apex along costa ; fringe pale glossy ochreous with a darker base. Head and thorax concolorous with fore wings ; abdomen paler. Underside dull whitish ochreous, with the lines indistinct.

Expanse of wings 46 millim.

One male from the Khasias.

Genus NOTARCHA, Meyr.

Notarcha semiflava, sp. n.

Fore wings fuscous, the lines and spots darker ; the costa paler, tinged with yellowish ; first line near base, indistinct ; a pale yellow spot in cell, preceded by a round blackish one and followed by a reniform one on the discocellular ; postmedian line of the usual form, forming three teeth in the sinus, dull blackish, edged externally with paler, which below the costa takes the form of a curved yellow blotch with lunate edges ; beyond the postmedian the ground-colour becomes darker ; fringe yellowish, chequered with brownish triangles. Hind wings yellowish, with the base, a discal spot, an outer thick rectangularly bent line, and the whole outer border dark fuscous ; fringe as in fore wings. Head, thorax, and abdomen olive fuscous ; base of abdomen yellowish. Underside pale straw-colour, with the markings dull leaden grey.

Expanse of wings 30 millim.

A few from the Khasias.

Notarcha paucinotalis, sp. n.

Fore wings mouse-colour, tinged with rufous ; first line only visible on inner margin as a dark shade, and a black dot below the median ; a small black dot in the cell and a slender black lunule at its end ; second line denticulate, interrupted, strongly curved outwards in the middle, reaching inner margin at two thirds, above which it is marked by a large black spot ; a marginal row of small black dots ; fringe concolorous. Hind wings darker, with a cell-spot and denticulate central line ; the basal area and inner marginal third suffused with dark grey. Head, thorax, and abdomen concolorous ; basal joint of antennæ, tongue, and pectus whitish

ochreous. Underside smooth, pale grey, with the outer line and cell-spot distinct in both wings, the line *not* interrupted.

Expanse of wings 40 millim.

One male from the Khasias.

Genus LOXOSCIA, Warr.

Loxoscia verecunda, sp. n.

Like *L. costalis*, Moore, but smaller and duller; pale grey. Fore wings with costa yellowish; the lines and spots obscurely darker and the central area slightly suffused with yellowish, especially towards the inner margin; the outer line consists of three equal oblique portions; the sinus contains a pale yellowish spot. Hind wings with basal two fifths pale, with a dark cell-spot; the rest with the fringes pale grey. Head, thorax, and abdomen yellowish. Underside still duller, with the markings fainter.

Expanse of wings 30 millim.

Several from the Khasias.

Genus GADESSA, Moore.

Gadessa impuralis, sp. n.

Fore wings straw-colour, with dull brownish-grey markings; the costa, especially at base, yellowish; lines somewhat blurred and indistinct, first at one fifth, slightly bent, and oblique outwards; second at three fourths, at first inwardly oblique, then describing a shallow sinus, incurved to below reniform stigma, with which it is connected by a grey diffuse blotch, and again oblique inwards, reaching inner margin before two thirds, and approximated to first line; a subbasal yellowish diffuse shade; a pale fuscous cloudy spot in base of cell and a darker cloudy cell-spot; hind margin greyish fuscous, diffuse, and broader towards costa and anal angle. Hind wings the same, without inner line and basal cell-spot; fringes straw-colour. Head, face, thorax, and abdomen straw-colour; collar and sides of patagia yellowish. Underside duller; the costa of fore wing and hind margins of both wings dull fuscous; the cell-spot and outer line only shown on fore wings.

Expanse of wings 28-30 millim.

Two males from the Khasias.

Very near to *mysisalis*, Wlk., from S. Africa, and apparently identical with specimens from the Nilgiris referred to that species by Mr. Hampson.

Genus CONOGETHES, Meyr.

Conogethes diminutiva, sp. n.

Fore wings yellow, with the lines indicated by black spots; a black dot at base; two subbasal spots on inner margin; first line sometimes vertical, consisting of three spots, often broken, the two lower spots nearer the hind margin; two spots in cell; exterior line consisting of ten or eleven spots, submarginal line of seven; the disk is often suffused with tawny, and in some instances the lower spots of the two lines coalesce, forming blotches in the central area. Hind wings with discal spot and two lines of black spots, the central line forming a black blotch on inner margin; fringes of both wings yellow. Head, thorax, and abdomen yellow, the latter generally with dorsal and lateral rows of black spots; anal tuft of male black. Underside like upper, but paler; the disk of fore wings often suffused with black.

Expanse of wings 17 millim.

Several from the Khasias.

Of the same size as *C. hamactalis*, Snell., but distinguished at once by the black, not reddish or purple markings. The suffused forms may be called var. *fulvida*.

Conogethes punctiferalis, var. *nigralis*, n.

The whole of the median area between the spots that represent the antemedian and postmedian lines suffused with blackish. This variety is exactly analogous with the variety *semifascialis*, Wlk., of *ersealis*, Wlk., from Moreton Bay, Australia.

Genus ARIPANA, Moore.

Aripana annulata, sp. n.

Fore wings white; a faint ochreous streak along costa at base and along hind margin from apex; a black spot at base, one on costa and inner margin near base, and a small one in base of cell; first line ochreous brown, only visible towards inner margin; a roundish large black cell-spot, sometimes with pale centre; obliquely beyond it a large finely edged brown or ochreous semiannulus; the ochreous or brownish diffuse exterior line starts from another similar semiannulus, is curved outwards towards hind margin, interrupted below the middle, and reappears on inner margin at three fourths; opposite the gap is a black spot near the hind margin. Hind wings with black cell-spot and ochreous sinuous interrupted

exterior line, with a black spot on it at inner margin and another near hind margin in the middle; fringes whitish. Head, thorax, and abdomen white; two black spots on the sides of the second abdominal segment. Underside suffused with pale fuscous, with only the discal spots marked and the edges of the costal annuli. In one of the two examples the exterior line is much nearer the hind margin than in the other.

Expanse of wings 24–26 millim.

Two males from the Khasias.

Aripana? candidalis, sp. n.

Fore wings white; basal area tinged with grey and with two small black dashes, one in the middle, the other on inner margin; first line blackish at one fourth, curved, with a black costal blotch along its upper half; second line from middle of costa, followed on costa by a large black blotch, forming an acute projecting beak below middle towards anal angle, and ending vertically on inner margin at three fourths; lower third of median area pale fulvous; an elongated black discal spot and a round blackish apical spot; fringe white, with a black basal line at apex. Hind wings white, with the whole outer third interruptedly blackish, the white ground-colour forming a small sinus in the middle; fringe white, with yellowish base and darker dividing line. Head, thorax, and abdomen white; basal segments of abdomen tinged with grey; anal segments black. Underside like upper; in the hind wings a black outer line with rectangular sinus is visible.

Expanse of wings 17 millim.

One female from the Khasias.

Aripana radiata, sp. n.

Fore wings white, with a faint ochreous tinge in places; a minute black dot at base of costa, a black spot on median near base, and another on inner margin further from base, the three lying in a curve; a black spot on costa at one third, from which the first line runs vertical to inner margin; a small black dot in cell and large black spot at end; a black streak from below the small dot obliquely to inner margin before anal angle; another from below the discal spot, divergent from the first, to hind margin above anal angle; a row of black marginal spots increasing in size as they approach the anal angle; a thick black outer line from

costa beyond two thirds, oblique as far as third median, below which it turns and runs straight outwards to hind margin; fringe white. Hind wings with large black discal spot, with a smaller one nearer base, and black postmedian line forming two large curves, one round the cell, the other below it, to a black spot on inner margin; fringe white beyond a black marginal line. Head, thorax, and abdomen white, tinged with greyish ochreous; a pair of black spots on front of thorax and first segment of abdomen. Underside white, with the markings fainter and in part obsolete.

Expanse of wings 28 millim.

Two females from the Khasias.

Genus DICHOCROCIS, Led.

Dichocrocis fuscifimbria, sp. n.

Fore wings deep yellow, suffused with orange; first line at one fourth, oblique outwards, and angled on the median, thick, dark brown; outer line at four fifths, parallel to hind margin, forming a sinus over the three median nervules, running shortly inwards along the first median, and reaching inner margin at three fourths; cell-spot large, brownish; a smaller dot in cell towards base; fringes leaden grey, with a darker basal line. Hind wings like fore wings, without the basal line, and with the cell-spot smaller. Head, thorax, and abdomen orange. Underside paler, without basal line.

Expanse of wings 24 millim.

Several of both sexes from Humboldt Bay, New Guinea.

PLATEOPSIS, gen. nov.

Fore wings with costa straight, curved only at base and before apex, which is blunt; hind margin obliquely rounded. Hind wings with both angles and hind margin evenly rounded. Forehead broad, projecting, and flattened, with a small blunt tooth in front; labial palpi obliquely ascending; second joint thick, third small and pointed; maxillary palpi invisible; tongue small; antennæ thick, short, lamellate, and pubescent. Neuration: fore wings, cell not half as long as wing, first median at five sixths, second, third, and lower radial at even distances from each other, third from end of cell; upper radial from just above middle of discocellular; last subcostal from end of cell, which is bent down, so that the nervule seems to rise from the discocellular; stem of third and fourth from just before the angle, the second close to the latter, first not far before second, bent up towards costal. Hind wings

with cell very short; costal approximated to subcostal near base; first subcostal anastomosing for a considerable distance with the costal; medians and radial all approximated from the lower angle of cell.

Type *Plateopsis vespertilio*.

Plateopsis vespertilio, sp. n.

Fore wings mouse-colour, smooth, without irroration; lines dark, thick, first near base, vertical to inner margin before one third, the costal portion invisible; a large blackish cell-spot; exterior line at three fourths, parallel for one third to hind margin, then forming a tridentate shallow sinus, running in to beneath the discal spot, thence very thick to inner margin; fringe concolorous, with a white spot at anal angle. Hind wings the same, with outer line only; white spot in fringes near anal angle larger. Head, thorax, and abdomen all concolorous. Underside whitish, with discal spot and outer lines represented.

Expanse of wings 22 millim.

One male from the Khasias.

A very distinct looking insect.

Genus COPTOBASIS, Led.

Coptobasis biocellata, sp. n.

Fore wings dull olive-fuscous; first line near base, bent in middle, the lower arm vertical; second line at three fourths, obscurely dentate, and hardly forming a sinus, running in very shortly along the second median, and thence obliquely to inner margin at two thirds, faintly edged with paler throughout; first spot horizontal, oval, with slightly paler centre and dark edge; the second lunular; fringe concolorous, without lines. Hind wings with dark discal spot and dentate outer line. Head and thorax concolorous, the abdomen much paler. Underside whitish cinereous, with the lines and spots a little darker. Antennæ of male with small but distinct basal process.

Expanse of wings 28 millim.

Both sexes from Tenimber.

Coptobasis incrassata, sp. n.

Fore wings glossy fuscous, the costa dark fuscous; first line at one fourth, oblique outward, thick; second line at two thirds, running vertically straight without a sinus to the

second median, along which it runs to below the discocellular, and thence to inner margin beyond middle, forming two right angles at the bends; a round blackish spot in cell and a dull whitish, thickly dark-edged lunule on discocellular; fringes glossy, concolorous, with a broad dark line at base, preceded by a very narrow pale one. Hind wings like fore wings, but rather paler, with an obscure darker central line; fringes with their apices whitish. Head, thorax, and abdomen concolorous. Underside whitish cinereous, with the markings darker. The antennæ of the male are strongly pubescent and have an enlarged bifid process from the basal joint.

Expanse of wings 26 millim.

Several from the Khasias.

POLYCORYS, gen. nov.

Distinguished from *Coptobasis*, Led., by the antennæ of the male, of which the basal joint is much enlarged and clothed with a tuft of hair, the shaft of the antennæ being articulated to its extremity; the first fourth of the shaft is thickened, with closely lamellate joints, the rest filiform. Labial palpi porrect, stout, densely hairy beneath, the third joint concealed; maxillary palpi slender, porrect above the labial. Collar and shoulders with erect tufts of scales; patagia and wings clothed with long coarse hair-like scales.

Type *Polycorys seminigralis*, sp. n.

Coptobasis crotonalis, Wlk., belongs to this genus.

Polycorys seminigralis, sp. n.

Fore wings greyish fuscous, dusted with dark fuscous; first line near base, dark fuscous, angled in middle, the lower arm vertical; orbicular stigma round, the reniform lunate, obliquely curved, both dark-edged, with their centre of the ground-colour; second line distinct, blackish, dentate, from costa at about two-thirds, vertical for its first third, vertical but slightly nearer hind margin in the middle, slightly oblique, without denticulations, and strongly marked, above inner margin; a row of black dashes along hind margin separated by the pale veins; from inner margin near base a dark suffusion extends to hind margin below apex, embracing the whole outer half of wing except the paler edging of the second line; fringe fuscous. Hind wings with blackish cell-spot; second and marginal lines as in fore wings. Head, thorax, and abdomen grey mixed with dark fuscous; tip of abdomen pale. Underside paler grey, with the lines and spots distinct.

Expanse of wings 36 millim.

Several males from the Khasias.

Genus NOSOPHORA, Led.

Nosophora triguttalis, sp. n.

Intermediate between *conjunctalis*, Wlk., and *chironalis*, Wlk., having in the fore wings the two spots of the former and in the hind wing the round spot of the latter. The hind wings beneath possess the bed of scales above the cell.

One male from the Khasias.

The basal segment of the abdomen is white.

Genus CYCLARCHA, Warr.

Cyclarcha monomma, sp. n.

Fore wings straw-yellow, suffused with greyish fuscous beneath the median vein for two thirds from the base, the veins themselves remaining paler; no markings whatever, except a large round velvety black discal spot; fringe straw-colour. Hind wings the same, with the fuscous suffusion deeper and embracing the whole wing except the hind margin; a faint dark brown cell-spot and a submarginal wavy line, edged externally with paler. Head, face, and palpi straw-colour; abdomen dark brownish fuscous. Underside glossy straw-colour, with the round discal spot of fore wings distinct and a cinereous shade across the disk of both wings.

Expanse of wings 20 millim.

One male from the Khasias.

PANTÆOCOME, gen. nov.

Wings both in shape and markings like *Acharana* and *Pachyzancla*; labial palpi short and broad, bluntly triangular, the third joint quite invisible; maxillary palpi erect, filiform; tongue and ocelli present; antennæ in female simple, in male pubescent; in the male the middle femora and tibiæ are largely developed; the hind femora and tibiæ are clothed with smooth shiny scales, concealing a mass of expansible fluffy hair and with a thick short tuft at the extreme base; from the base of the inner margin of hind wing springs a long tuft of stiff hairs.

Type *Pantæocome deformis*, sp. n.

Pantæocome deformis, sp. n.

Fore wings dull grey, with the costa darker; the lines and cell-spots almost exactly as in *stultalis*, the first near base, curved, the second at three fourths, forming three teeth in its

upper third, three more in the sinus, and one large tooth in the lower third above the middle of inner margin, edged throughout with paler. Hind wings the same. Underside much paler, whitish towards base. The covering scales of the hind legs are glossy white, the fluffy hairs beneath grey, and the basal tuft blackish; the tuft of stiff hairs from the hind wing brown-black.

Expanse of wings 24-28 millim.

Two males and one female from Tenimber.

Genus PACHYZANCLA, Meyr.

Pachyzancla granulata, sp. n.

Fore wings rufous or fuscous, thickly irrorated with darker atoms; the lines dark fuscous, often very indistinct, first at one fourth, bent in middle and vertical below the bend to inner margin; second at three fourths, parallel to hind margin, forming a rectangular tridentate sinus in the middle, running in along second median to below the discocellular, and thence to inner margin at two thirds; a dark spot in cell and a dark lunule at the end; fringes glossy grey, with a dark basal line preceded by a fine paler one. Hind wings like fore wings, with the first line wanting. Head, thorax, and abdomen concolorous, basal segments of abdomen paler. Underside duller.

Expanse of wings 26-28 millim.

Several from the Khasias.

Genus SYNTOMODORA, Meyr.

Syntomodora plumbeolis, sp. n.

Fore wings leaden grey, with the costa straw-colour; first line at one fourth, nearly straight, second at two thirds, forming a shallow sinus to below discocellular, thence straight to inner margin beyond middle; it is preceded on the costa by a pale straw-coloured blotch; hind margin narrowly and diffusely straw-colour, slightly interrupted in the middle; fringes grey, pale straw-colour at apex and above anal angle. Hind wings the same, without the basal line. Head, face, and abdomen yellowish; thorax grey. Underside leaden grey, with the costal blotch large and conspicuous, the lines indistinct.

Expanse of wings 26 millim.

Two males from the Khasias.

Genus ORPHANOSTIGMA, Warr.

Orphanostigma versicolor, sp. n.

Fore wings yellow, suffused with orange; the lines as in *latimarginata*, Wlk.; marginal area dark violet-fuscous; in the hind wings the line from the discal spot to anal angle is always slightly bent, whereas in *latimarginata* it is quite straight, and the space between it and inner margin is orange, whereas in *latimarginata* it is the pale yellow of the ground-colour. Head, thorax, and abdomen bright orange.

Expanse of wings 18 millim.

Latimarginata is always larger—22–24 millim.

A variety occurs in which the orange tints are superseded by fuscous grey.

Several examples from the Khasias. In the B. M. collection are examples from the Nilgiris.

Genus PATANIA, Moore.

Patania? excurvalis, sp. n.

Fore wings dark mouse-colour; a short subbasal line, black on costa; first line at one fifth, blackish, wavy, vertical, edged with pale yellowish internally; second at three fourths, oblique inwardly from costa, along which it runs for a short distance towards apex to a pale yellow costal spot, and edged internally by a curved yellowish blotch; at one third it is abruptly bent outwards along the lower radial, forming a narrow tridentate sinus, then as abruptly recurved to beneath the yellow costal patch and bent to inner margin at middle; fringes straw-colour, with their inner half chequered with darker, and a dark basal line. Hind wings like fore wings, with an exterior line only. Head, thorax, and abdomen concolorous; anal tuft pale. Underside paler, with the markings more distinct than above.

Expanse of wings 24 millim.

One male from Mackay, Queensland.

Distinguished from *Patania? appensalis*, Snell. (*Entephria*), by the different course of the outer line and by the chequered fringes.

Genus DOLICHOSTICHA, Meyr.

Dolichosticha subauralis, sp. n.

Like *D. perinephes*, Meyr., from Fiji, but the ground-colour pale yellow, slightly lustrous; the marginal fuscous

band projects basewards slightly at anal angle of fore wings and decidedly in the hind wings, the first part of the outer line running to its angle and forming the edge of the fuscous border to the anal angle. Underside yellowish. Abdomen and thorax with patagia yellowish; head and collar fuscous.

Expanse of wings 20 millim.

Several from the Khasias.

LASIIACME, gen. nov.

A development of *Marasmia*, Led.; like it the male fore wing has a large fovea in the cell, covered with a flock of hair above, and containing woolly hair beneath; but the present genus is characterized by the length of the abdomen in the male and by the presence on the apex of hind wings of male of a bed of hair-like scales on the upper surface. The neuration is inconstant; in one species the second subcostal is free and closely approximated to the stem of the third and fourth, in the other it is stalked with them; so that, if neuration alone were followed, one would have to be placed in *Dolichosticha*, Meyr., the other in *Epimima*, Meyr., the types of which two species are without the hair-covered fovea in the cell.

Type *Lasiacme pilosa*, sp. n.

Lasiacme pilosa, sp. n.

Fore wings almost wholly suffused with dark fuscous grey, the usual pale ground-colour only appearing beyond the postmedian line; this runs obliquely parallel to hind margin for two thirds, is very shortly curved in between first and second median, then oblique again to inner margin at middle, where it approximates to the end of the first line, which is very obscure; costa between the two lines with dark spots; tuft of fovea dark fuscous, the expansible tuft of hair white; marginal area and fringes dark fuscous. Hind wings white, with broad fuscous border, narrowing to a point at anal angle; a dark linear cell-spot; the upper part of the postmedian line forms a short streak from below the costa a short way in front of the inner edge of the costal border; the lower part forms a continuation of the linear cell-spot to the anal angle; within this line the inner margin is slightly tinged with fuscous; the bed of hairs on the hind wings is narrow and extends from apex nearly halfway to base. Underside duller; the foveal space, which is oblong and large, ochreous white; the down when expanded whitish. Frenulum long

and stout; the retinaculum elongated and some distance from base of wing.

Expanse of wings 24 millim.

One male from the Khasias.

In the fore wings of this species the second subcostal is free.

Lasiacme mimica, sp. n.

Answers exactly to the description of *Epimima stereogona*, Meyr., with which it also agrees in neururation, the second, third, and fourth subcostals being stalked. On the hind wings the bed of hair at the apex is not narrow and confined to the costa as in *L. pilosa*, but spread over the whole apical region.

Expanse of wings 18-20 millim.

Two males from the Khasias.

Genus PLATAMONIA, Led.

Platamonia binotalis, sp. n.

Fore wings dull yellowish, much suffused with fuscous, the only clear yellowish space being within the sinus of the outer line; costa and base broadly suffused with deep fuscous; first line at one fourth, hardly curved, preceded by a narrow cloudy yellowish space; second at two thirds, dark from the costa, where it is preceded by a small yellowish spot and followed by a yellowish space, forming a slight wavy sinus and running in beneath the discal spot, reaching inner margin at two thirds; discal spot lunate, blackish, preceded by a yellowish blotch; marginal area wholly dark fuscous; fringe grey, with a dark line following a finer pale one at base. Hind wings with discal spot and outer line as in fore wings; pale yellow to line, fuscous beyond. Head and thorax fuscous; abdomen deep yellow, with fuscous rings; ultimate and penultimate segments both marked above with a white ring, divided in three parts by a black lateral dash on each side. Underside dull gilded yellow, suffused with darker; the outer line and cell-spots blackish.

Expanse of wings 22 millim.

One male from Upper Burma.

Like *abjungalis*, but not nearly so dark.

[To be continued.]

XXIX.—*Report upon the Scorpions, Spiders, Centipedes, and Millipedes obtained by Mr. and Mrs. E. Lort Phillips in the Goolis Mountains inland of Berbera, N. Somaliland.*
By R. I. POCKOCK.

[Plate XI.]

MOST of the examples composing this collection were obtained at an altitude of two or three hundred feet.

SCORPIONS (SCORPIONES).

Family Buthidæ.

Parabuthus granimanus, Pocock.

Parabuthus granimanus, Pocock, Journ. Linn. Soc., Zool. xxv. p. 311, pl. ix. figs. 4-4 d (1895).

This species was originally based upon specimens obtained by Mr. E. W. Oates at Zeyla in Somaliland; but in the same paper mention is made of some paler specimens from the Somali coast. Mr. and Mrs. E. Lort Phillips brought back a single young female example of this paler form.

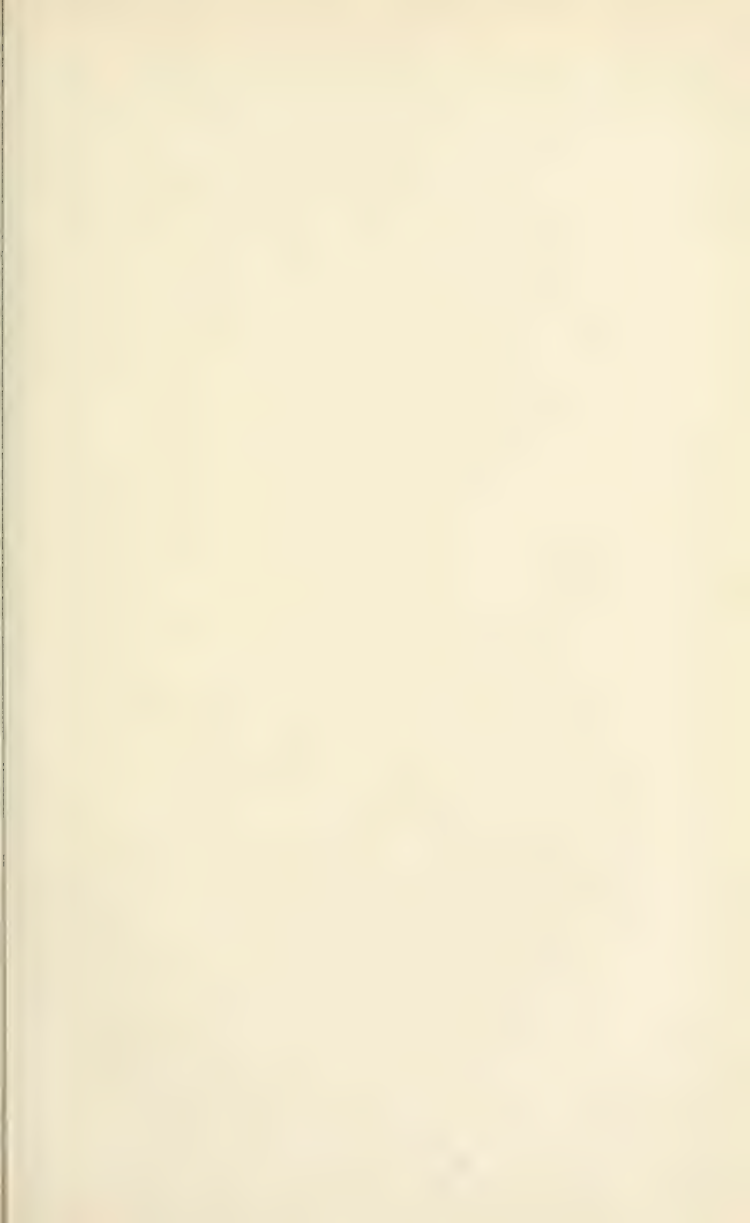
Buthus polystictus, sp. n. (Pl. XI. fig. 1.)

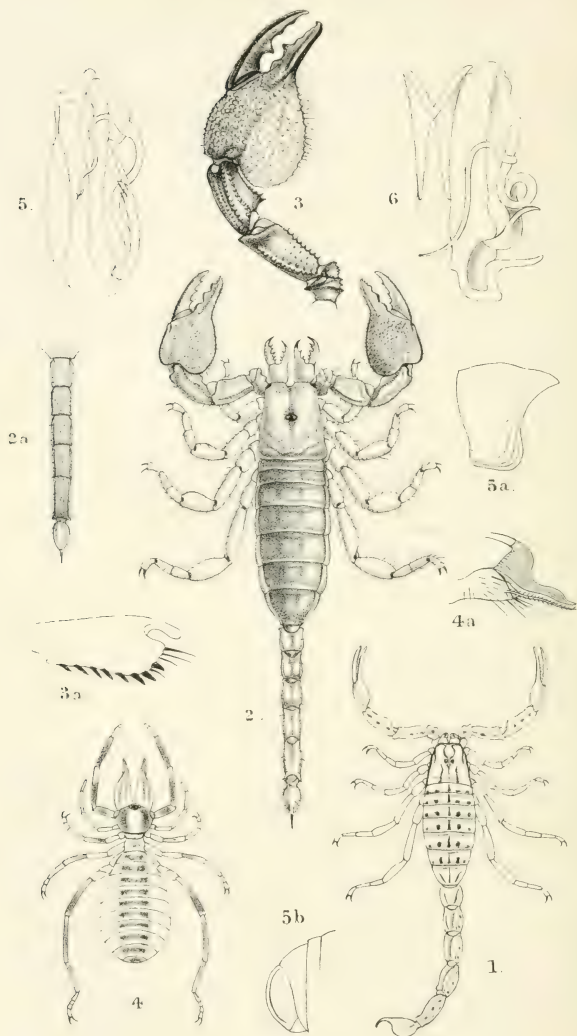
Belonging to the section of the genus of which the West-African *B. hottentotta* is the type.

Colour a clear lemon-yellow, spotted with black, the anterior edge of the carapace, the ocular tubercle, and the anterior and posterior median keels, as well as the lateral margin and a stripe behind the lateral eyes, black; each tergite except the last ornamented with five transverse spots, the three median of which are on the three keels; tail pale above, but the segments 1 to 4 adorned below with 12 round spots, 3 upon each of the four inferior keels; corresponding spots, but not so regularly arranged, upon the lower side of the fifth, each pigment-spot surrounding a bristle-pore; similar spots upon the upperside of the brachium and humerus of the chela; external surface of the manus very feebly infuscate; femora of legs slightly infuscate, and patellæ minutely spotted; whole of the lower surface of the trunk, legs, and chelæ pale.

In granulation and development of keels the species comes near *Buthus Eminii**, which I described from a male specimen obtained upon the shores of Lake Tanganyika, and of

* Ann. & Mag. Nat. Hist. (6) vi. p. 98 (1890).





which I have subsequently seen the female examples obtained by Dr. J. W. Gregory at Ndara and the Athi plains, but the granulation of the trunk is altogether less coarse and the structure of the tail is different.

In the female of *B. Eminii*, and much more so in the male, the segments are all higher and thicker, the height of the fourth, for example, being equal to the length of the first and to considerably more than half its own length, whereas in *B. polystictus* the height of the fourth is barely half its own length and is distinctly less than the length of the first. Again, in *B. polystictus* the upper surface of the segments is much less strongly excavated and the superior keels are not so high nor so coarsely granular, nor is the terminal granule particularly prominent; this is very noticeable in the fifth segment, where the sides of the upper surface are convex and distinctly higher throughout the length of the segment than are the weakly granular side crests; moreover, the length of the fifth segment exceeds twice its width, which is not the case in *B. Eminii*; the vesicle, too, is larger and differently shaped, its height being equal to its width and equal to the width of the upper surface of the fifth, and is scarcely noticeably geniculate under the vesicle, which is only very slightly curved. In *Eminii*, on the contrary, the height of the vesicle is less than its width and less than the width of the upper surface of the fifth; the vesicle is also strongly angled beneath the aculeus, and the latter is strongly curved.

In the chelæ the hand is as wide as the forearm, the digits are long, the movable twice the length of the hand-back and furnished with 12 rows of teeth along the median series, the basal row (composed of 19 denticles) being twice the length of the others, which contain 8 to 10 denticles, and evidently formed of two undivided shorter rows, as is shown by the presence on each side of it of a tooth of the external series. In *B. Eminii* there are 13 rows of median teeth, two corresponding to the undivided basal series in *polystictus*; but the basal row is composed of 10 teeth, the one immediately in front of it of 5, and the rest of from 6 to 8, almost always 7, and owing to the greater shortness of the digits the rows are more crowded together.

Pectinal teeth 18-19 and 20-20.

Measurements in millimetres of type.—Total length 55; length of carapace 6, of tail 31; width of first caudal segment 3·5, of fifth 2·8, length of latter 6·5, height 2·8; length of hand-back 3·5, of movable digit 7; width of hand 2·5.

Family Scorpionidæ.

Scorpio Colei, sp. n. (Pl. XI. figs. 2, 2 a.)

Colour of trunk yellowish green above; tail palish yellow above, infusate below, especially on segments 3 to 5, the fifth slightly infusate above; vesicle clear yellow; legs and chelæ and coxal areas clear yellow; hands reddish yellow, with the crest of the hand-back and the teeth on the digits blackish.

Carapace as long as caudal segments $1 + 2 + \frac{1}{3}$ of 3, smooth and polished above, granular at the sides, the anterior margin with a deepish median notch and its side-lobes squared as in *Sc. viatoris*, and weakly granular towards the middle; median eyes well in front of the middle (*cf.* measurements).

Terga smooth and polished, the last granular at the sides and behind, the crests scarcely visible.

Sterna smooth and polished, *the last granular in its posterior half*, as in some species of the South-African *Opisthophthalmus*.

Tail short, weak, about two and a half times the length of the carapace; the upper surface of the segments 1 to 4 slightly excavated and weakly granular, especially posteriorly, the superior crests very weak and weakly granular, absent on the fifth; sides of the segments nearly smooth; *the lower surface of segments 1 to 4 thickly granular*, the median keels obsolete, the lateral distinct, the intercarinal spaces on the lower surface of the fifth also coarsely granular. *Vesicle* small, narrow, granular below.

Mandibles as in the East-African species *Sc. cavimanus* and *viatoris*, with the penultimate fang much shorter than the last.

Chelæ moderately robust; humerus granular above and in front, and weakly so at the base below; brachium smooth below and punctured behind, as in the other African species, its upper crest granular, its posterior and anterior surface also finely granular; *manus* entirely covered above with coarse granules, not crested, the crest defining the hand-back very strong but smooth; inner edge of the hand granular except behind on the lobe, which is smooth; lower surface granular almost throughout, scarcely crested; digits normal, the movable considerably shorter than the carapace but equal to the width of the hand.

Legs smooth, the penultimate and antepenultimate segments, with the exception of the spine at the apex, not spiny externally, but armed with setæ as in *Opisthophthalmus*

Wahlbergi; tarsi armed almost as in *Sc. viatoris* &c.—that is to say, the lobes are furnished with 2 spines, 1 median and 1 inferior, while behind on the lower surface there are 3 or 2 and in front 1, so that altogether there are 7 or 8 spines.

Pectines furnished with 11 teeth.

Measurements in millimetres.—Total length 71; length of carapace 12, width 11·5, distance of eyes from hinder margin 7; length of tail 33; width of hand and length of movable digit 9·3.

A single, apparently not quite adult, female example; dedicated to Miss Edith Cole, who accompanied Mr. and Mrs. E. Lort Phillips on the expedition.

This is, perhaps, one of the best-marked species of Scorpion that has been described of late years. From the structure of the lower surface of the brachium and the spine-armature of its tarsi and the dentition of the movable digit of the mandibles it falls into the East-African section, of which *Sc. cavimanus* and *Sc. viatoris* are the only examples known to me. But from these it differs, as well as from all the other members of the genus, in having the lower surface of the last abdominal segment and tail thickly granular.

Scorpio Phillipsii, sp. n. (Pl. XI. figs. 3, 3 a.)

♀. Allied to *Sc. Gregorii*, Poc., but differs in the following particulars:—

Colour of the upperside of the trunk a brownish or reddish yellow, the tail darker towards the extremity; chelæ reddish yellow, with darker tubercles and green fingers; legs and ventral surface a uniform pale yellow.

Tail shorter than in *S. Gregorii*, being only a little more than three times the length of the carapace, than which its first and second segments are considerably shorter, the superior crest of the second, third, and fourth much less strongly denticulate; the vesicle, too, is a little differently shaped, being distinctly wider than in *Sc. Gregorii*, its width exceeding that of the third caudal segment and equalling that of the second, while its height is less than the width of the fifth segment.

Chelæ almost as in *Sc. Gregorii*, but the sculpturing of the hand composed of much more distinctly defined tubercles and spreading right over the posterior lobe of the hand; the upper surface of the hand, moreover, is much less convex, which gives it a sharper inner edge and a smaller height; the lower surface, moreover, has about half of its area covered with granules.

Legs smoother, the granules on the femora scarcely perceptible; *tarsi* spined as in *Sc. Gregorii*, but one of the setæ on the apex of the lobe, especially noticeable on the third and fourth, thickened and spiniform, though with a filiform tip; it thus approaches the completely spiniform condition that is met with in *Sc. exitialis*, Poc., and *Sc. arabicus*, Kraep.

Pectinal teeth 15-16.

Measurements in millimetres.—Total length 100; length of carapace 15·3, of tail 50·5; length of segment 1+2 13; length of hand-back 10·5, of movable digit 16; width of hand 14·8, height of hand 6·5.

A smaller male example taken with the above, and measuring 96 millim. in length, with the carapace 14 and the tail 49—that is, just $3\frac{1}{2}$ times the length of the carapace—has 16-17 pectinal teeth, but the digits are normally constructed. This example has evidently not attained its full complement of sexual characters. Mr. Lort Phillips, however, picked up the isolated pincers of a large male, which show that these appendages are modified in this sex in the same way that they are in *exitialis* and *Gregorii*—that is to say, the movable digit is furnished with one long triangularly tuberculiform tooth, which closes behind a smaller though somewhat similar tooth on the immovable digit. These fortunately recovered fragments show, moreover, that the species evidently reaches a larger size than one would suppose to be the case from examining only the two entire specimens; thus the hand-back is 11·5 millim. long, the movable digit just 19, and the width of the hand 16·3. Thus a simple calculation from the measurements of the carapace, abdomen, and tail of the smaller male, as compared with the measurements of its hand, shows that the male to which these pincers belonged probably exceeded 120 millim. in length.

Loc. Dooloob, inland of Berbera.

SPIDERS (ARANEÆ).

Nephila sumptuosa, Gerstaecker.

Nephila sumptuosa, Gerstaecker, Von der Decken's Reisen in Ost-Afrika, iii. 2, p. 501, pl. xviii. fig. 12.

A large number of specimens of this handsome species, which has a wide range in East Africa, and occurs also in Socotra (*I. B. Balfour*, *Mus. Brit.*), were obtained.

Gastracantha ensifera, Thor.

Gastracantha ensifera, Thor., Öfv. Vet.-Akad. Förh. xvi. no. 7, p. 302 (1859).

Described originally from Caffraria.

The specimens here identified are similar to examples from Shoa, in Abyssinia, identified by Pavesi, which the British Museum has received from the Marquis G. Doria.

Hermippus loricatus, Simon.

Hermippus loricatus, Simon, Ann. Soc. Ent. Fr. 1893, p. 316.

A single female specimen of this species, which was originally obtained near Lake Tanganyika.

Sparassus Walckenaerii, Aud.

Sparassus Walckenaerii, Aud. in Savigny's Description de l'Egypte, Arachnides, p. 159, pl. vi. fig. 1.

Lycosa tarentulina, Aud.

Lycosa tarentulina, Aud. loc. cit. p. 143, pl. iv. fig. 2.

This species and the preceding were obtained originally in Egypt.

Lycosa Raffrayi, Simon.

Lycosa Raffrayi, Simon, Ann. Soc. Ent. Fr. (5) vi. p. 76, fig. 23 (1876).

Recorded originally from Zanzibar.

Heligmomerus somalicus, sp. n.

Carapace smooth and polished; cephalic portion flat on the top, scarcely elevated behind the eyes.

The anterior lateral *eyes* (the forward pair) almost sessile, each with its own tubercle; the anterior median separated from each other by a space which is about equal to their diameter, but at least twice this distance from the posterior lateral, the latter elliptical; posterior medians subcircular, close to though not touching the postero-lateral border of the anterior medians, than which they are rather smaller, separated from each other by a space which about equals four diameters, and from the posterior lateral by a space which slightly exceeds their diameter. A pair of strong bristles, with a smaller one between them, rising in front of the anterior lateral eyes; one bristle between the anterior medians and a pair between the posterior medians, one close to each eye.

The front of the *mandible* studded with thick reddish bristles, intermixed below with the short, blunt, tuberculiform spines which spread upwards from the short angular prominence; lower edge of mandible furnished externally with 9 blunt rounded teeth and internally with 7 or 8.

Labium armed apically with a crescentic series of 6 teeth.

Maxilla armed in front throughout its length with teeth, but more crowdedly on the two extremities; the rest of its lower surface studded with short spicular hairs.

Sternum hairy in front, smooth behind, with only two pairs of impressions, opposite the middle of the coxæ of the legs of the first and second pairs; the posterior larger, oval, further from the margin than the anterior, the space separating each from the edge being about equal to half its long diameter.

None of the coxæ of the *legs* spicular, but hairy, the first more so than the second, the second than the third, and the third than the fourth; femora of third and fourth inflated below; patella, trochanter, and femur of palp and of first and second leg studded in front with stiff bristles, of third and fourth legs nearly smooth; patella of palp with 1 internal spine and some stiff bristles, of first and second leg hairy, of third and fourth furnished with hairs mixed up with short spines; tibia, protarsus (and tarsus) of palp, and first and second legs thickly spiny in front and behind (externally and internally), though the spines on the posterior surface of the second tibia are only about half a dozen in number; tibia of third shorter than patella of third, armed like the protarsus with spines in front and behind, the protarsus also armed below with an apical spine, the tarsus apically spined both externally and internally; tibia of fourth bristly, furnished with only one small anterior spine; protarsus armed below with 5 spines; tarsus with many spines and rather thickly hairy. Tarsal claws with one large tooth (with sometimes a smaller tooth at the base of it).

(Abdomen absent.)

Length of carapace 8.6 millim., width 7.5.

A single female example.

The genus *Heligmomerus*, hitherto known only from Ceylon and South India, contains but two species, *H. taprobanicus*, Sim., from Kandy, and *H. prostans*, Sim., from Kodeikanel, South India. This new form certainly differs from both in having the anterior median eyes much nearer to each other than they are to the laterals, for, according to Simon's diagnosis of the genus, these four eyes are equidistant.

SOLIFUGÆ*.

Solpuga dentatidens (Sim.).

Gætulia dentatidens, Sim. Ann. Soc. Ent. Fr. (5) ix. p. 115, pl. iii. fig. 9 (1879).

This species was described from a single mutilated male brought by M. d'Arnauld from the banks of the White Nile ("du fleuve Blanc"). I am not aware that it has been recorded since from any locality; consequently the capture of two adult male examples by Mr. and Mrs. E. Lort Phillips is of great interest.

Rhax ornata, Poc., *Phillipsii*, subsp. n.

Closely resembling *R. ornata*, Poc.†, from Mombasa, in size and colour, but differing in the following particulars:—The colour of the trunk is identical in the two, except that in *R. Phillipsii* the antero-lateral angles of the carapace are broadly fulvous, whereas in *R. ornata* only the border is of this colour; the mandibles are a uniform reddish brown, and not yellow above and black at the sides, as in *ornata*; the legs are almost wholly fulvous, the black bands present in *R. ornata* being represented by very faint spots; and, lastly, the protarsus of the palp is a uniform reddish brown throughout, whereas in *ornata* it is yellow at the base and black in its distal two thirds.

A single male example was obtained:

Biton brunnipes, sp. n. (Pl. XI. figs. 4, 4 a.)

Colour.—Head brownish, pale in the middle; thoracic terga pale; abdominal terga brownish; mandibles yellowish, with two brownish bands on their upperside; palpi with femur distally brownish, the apex only pale; patella with its two extremities pale, the rest brownish; tibia coloured like the patella, but darker, tarsus dark yellowish; first, second, and third legs almost entirely pale, fourth leg with distal half of femur, whole of the patella, and proximal half of tibia brownish black; coxal areas of cephalothorax entirely pale yellow.

Carapace elevated, hairy, anterior border moderately convex;

* According to Mr. Lort Phillips, these Arachnids are known to the Arabs by a name which may be spelt "Gailybogs."

† Ann. & Mag. Nat. Hist. (6) xvi. p. 93, pl. iv. fig. 2.

ocular tubercle large, bristly in front, the distance between the eyes exceeding a diameter.

Mandibles bristly, the upper fang moderately curved at the apex, furnished with 11 teeth, 8 in a continuous line and 3 on the inner side near the base; of the 8 constituting the long series the 2 distal ones are large, subequal, and blunt, then comes 1 small one, then 1 large, and these are followed by 4 medium-sized teeth, which form the outer row at the base of the fang; the lower movable fang is furnished with 2 large widely separated teeth and a very small one between them. The inner surface of the mandible convex, the stridulating-ridges long and strong; feathery hairs at the base of the upper and lower digit.

Rostrum horizontal, compressed, its upper edge straight; the tips of its upper and lower lips on a level with each other.

Palpi moderately robust, clothed with short hairs intermixed with long setæ, some of which on the lower surface of the tibia are short and spiniform; tibia stouter in the middle than at the ends; the tarsus a little narrowed at the base, but immovably united to the tarsus.

Legs.—First and fourth unspined; tibia of second armed above with 5 spines, of third with 3; femora of fourth a little enlarged and compressed.

Length, including mandible, 16 millim., of mandible 4, of head 2.5; width of head 3.

A single female example.

CENTIPEDES (CHILOPODA).

Scolopendra valida, Lucas, subsp. *deserticola*, Poc.

Scolopendra valida, Lucas, subsp. *deserticola*, Poc. Journ. Linn. Soc. xxv. p. 297 (1895).

The discovery of a representative of *Sc. valida* on the continent of Africa is of great interest, the species being hitherto known from the Canary Islands (*valida*, typical form), S. Arabia (subsp. *deserticola*), the Persian Gulf (subsp. *persica*), and Socotra (subsp. *Balfouri*). The conclusion that the species once occupied the whole of the Mediterranean area that lies between the most easterly and westerly points of its present range can hardly be doubted; but there is at present no evidence that it exists in Africa between Egypt on the east and Morocco on the west.

Cormocephalus mirabilis, Porat.

Cormocephalus mirabilis, Porat, Bih. Sv. Vet.-Akad. Handl. iv. no. 7, p. 18 (1876).

Two examples of this species, recorded originally from the White Nile in Kordofan, were obtained.

Lamnonyx punctifrons (Newport).

Mecistocephalus punctifrons, Newp. P. Z. S. 1842, p. 179 (and of all authors).

Resembling the well-known Indian form, except that the body, excluding the first and second terga, which with the head and maxillipedes are castaneous, is of a uniform pale yellow colour, and that in the adult the sternal sulci are visible only to about the thirty-sixth segment, and from the thirtieth to the thirty-sixth are merely represented by a very short groove on the hinder border of the plate. This, at least, is the case in two presumably mature specimens measuring 63 and 73 millim. respectively in length, whereas in a young specimen (51 millim.) the sulcus is visible to the end of the body, and even on the last segment extends past the middle of the sternite. In this respect this young example resembles the Indian form.

It is difficult to say without further specimens what the exact value of this character may be.

MILLIPEDES (DIPLOPODA).

Archispirostreptus Phillipsii, sp. n.
(Pl. XI. figs. 5-5b.)

♂. Entirely black, with the anterior covered part of the segments yellowish red, and showing a spot of the same colour above the base of the legs.

Head nearly smooth, finely punctulate and striolate; no sulcus joining the inner angle of the eyes; four pores above the labral excision. *Eyes* acutely angled internally, separated by a space which about equals a diameter, composed of thirteen vertical rows of ocelli up to about 70 in number. *Antennæ* long, longer than the face by the two distal segments, the segments decreasing in length from the second to the sixth.

First tergite lightly striolate; the anterior angle of the inferior portion produced and convex, crossed by three ridges in addition to the one on the very margin.

On the rest of the segments the posterior portion is elevated: the transverse sulcus distinct, area in front of it finely ridged transversely, and, like the posterior part, densely punctulate; the lateral longitudinal crests reaching as high as the pore; pores small, separated by at least two diameters from the sulcus.

Sterna smooth.

Anal tergite coriaceous, short, its posterior border nearly transverse, only slightly angled; *valves* slightly surpassing it, marginally compressed; *sternite* semicircular, only subtriangular.

Legs, except the first and second pairs, with fourth and fifth segments padded, the pads produced at the distal extremity so as to overlap the end of the next segment.

Copulatory organ as in fig. 5; the shorter spiniform branch of the flagellum armed towards its apex with about half a dozen sharp teeth.

Number of segments 68.

Length about 130 millim., width 14.

Four male examples.

Archispirostreptus nigricolor, sp. n.
(Pl. XI. fig. 6.)

♀. Like the preceding species, entirely black in body, head, and limbs, but with an infusion of deep probably blood-red on the anterior portion of the anal segment, and on the inferior portions of the face and the anterior covered portions of the segments not so widely pale-coloured.

Head smooth, only finely striolate. *Eyes* composed of about 60 ocelli, which are arranged in twelve vertical rows. *Antennæ* longer than the face by the length of the sixth and seventh segments; the upper edge of the segments more convex than in the preceding species.

Collum or *first tergite* finely punctulate; its lateral portion crossed by two grooves or ridges, one close to the lower edge, the other higher. On the rest of the segments the posterior portion is scarcely elevated, the transverse sulcus being weak, the area behind it densely and finely sculptured with fine striolæ; the area in front of it similarly sculptured in its posterior half, transversely crested in front; the longitudinal grooves strong on the anterior segments, just falling short of the pore, weaker on the posterior and scarcely extending so high. *Pores* separated by nearly three diameters from the transverse groove.

Anal tergite but little produced, not quite reaching the summit of the valves, which have compressed margins.

♂. Smaller than the female; collum a little wider at the sides than in the female; legs padded as in the preceding species. Copulatory apparatus as in fig. 6.

Number of segments 56.

Length about 70 millim.

These two species, judging by the form of the copulatory organs, appear to be quite distinct from those that Silvestri has recently described from Somaliland.

EXPLANATION OF PLATE XI.*

Fig. 1. *Buthus polystictus*, sp. n. Nat. size.

Fig. 2. *Scorpio Colei*, sp. n. Nat. size.

Fig. 2 a. Ditto. Lower side of tail.

Fig. 3. *Scorpio Phillipsii*, sp. n. Hand from above.

Fig. 3 a. Ditto. Posterior foot from behind.

Fig. 4. *Biton brunnipes*, sp. n. $\times 2$.

Fig. 4 a. Ditto. Rostrum from the side.

Fig. 5. *Archispirostreptus Phillipsii*, sp. n. Left half of copulatory organ.

Fig. 5 a. Ditto. Side view of first tergite.

Fig. 5 b. Ditto. Side view of anal somite.

Fig. 6. *Archispirostreptus nigricolor*, sp. n. Left half of copulatory apparatus.

XXX.—Description of a new Species of Fruit-Pigeon from the Highlands of Mindoro, Philippine Islands. By JOHN WHITEHEAD.

Carpophaga mindorensis, sp. n.

Adult male. Most nearly allied to *Carpophaga radiata* (Quoy and Gaimard), but much larger. Top of the head, neck, breast, and rest of underparts bluish slate-grey, darkest on the belly and under tail-coverts, the latter indistinctly edged with rufous; forehead, cheeks, and throat pale whitish pink; feathers surrounding the eye and forming a patch above the ear-coverts blackish grey; hind neck gradually shading into sooty black on the mantle and interscapular region; scapulars and inner wing-coverts bronze-lake, changing to bronze-green on the rest of the wings, rump, and upper tail-coverts; primary-quills blackish grey, the inner ones glossed on the outer web and towards the extremity with metallic green; tail-feathers black, glossed with purple and green, and with

* [This Plate will be given in the next Number.]

a wide grey band across the middle ; under wing-coverts and axillaries slightly glossed with bronze.

Total length 19·0 inches ; exposed part of culmen 0·9 ; wing 9·2 ; tail 7·0 ; tarsus 1·38 ; middle toe and claw 2·0.

Adult female. Similar to the male, but rather smaller, and the under tail-coverts distinctly margined with chestnut.

Total length 17·5 inches ; exposed part of culmen 0·9 ; wing 8·8 ; tail 6·25 ; tarsus 1·3 ; middle toe and claw 1·8.

XXXI.—*Description of a new Spindasis from Ceylon.*

By FRANCIS A. HERON.

Spindasis Greeni, sp. n.

Hab. Pundaloya, Ceylon.

Expanse, ♂ 35 millim.

Description.—*Male.* Upperside : fore wing light violet-brown, the basal and discal areas, including the cell, sparsely covered with pale lilacine-blue scales.

In certain lights the brown assumes a warm golden tinge and in others an iridescent violet glosses the lilacine area.

Hind wing similarly coloured, but paler and greyer on the costa and inner margin. The iridescent violet extends from subcostal to submedian.

Both wings are outlined by darker brown scales and the scales of the fringes are very pale brown.

Underside : both wings pale ochreous brown, growing pearly towards the inner margin of the fore wing, especially along the veins ; sparse iridescent scales enrich the deadness of the ground-colour by gold in certain lights. The markings, in a darker shade of the ground-colour, are very much reduced, and very few are speckled with silver, those of the fore wing, cell, and hind wing-lobe being most conspicuously ornamented in this manner.

On the fore wing there are traces of a faint row of sub-marginal spots extending from the apex to the outer angle, the apical spots showing traces of a few silvery scales ; a bar marks the position of the discoidal, and another, parallel to it, within the cell, the origin of the first median vein ; another bar, almost continuous with the discoidal, but slightly displaced outwards, unites the median.

Below the origin of the third subcostal there is a small reniform spot, and faint traces of another exist beneath this.

The hind wing shows a faint series of spots continuous with that of the fore wing, and gradually increasing in distinctness till they are silver-scaled in the loop parallel to the lobe-margin. Usually well defined, the discal band is here reduced to three disconnected spots, the central one situated on the discoidals and the two others outwardly displaced.

Obscure traces exist of another row between the discal and submarginal bands, and there is a single spot within the cell.

The thorax and abdomen are concolorous with the wings.

The antennæ are similarly coloured above, darker at the tip, and below of a rich reddish brown.

Though quite distinct from any known species, this form most resembles the rare *Spindasis abnormis*, Moore.

In the shape of the wings *Greeni* is much squarer than the same sex of *abnormis*, the exterior margin being more erect and the apex less acute. The hind wing also is less produced.

The upperside of *Greeni*, which is much rubbed and faded, is paler and less blue than in *abnormis*, to some extent resembling *Polyommatus baticus* in its colouring, and the dull ochreous brown of the anal lobe so conspicuous in *abnormis* is absent in the species here described; but this may be only through fading.

The underside of *abnormis* ♂ is concolorous with that of the female, of a much redder ochreous than in *Greeni*.

The reduction of the underside marking, already noticeable in *abnormis*, is carried to such an extent in *Greeni* that only traces of the usual bands survive.

In *abnormis* ♂ the underside markings are in complete lines like those of the female, and have not the interruption and displacement characteristic of *Greeni*.

Both species were taken at considerable altitudes, whereas most forms of the genus are found on the lowland plains.

The specimen, unfortunately still unique, from which the description is taken was captured near Pundaloya, on the summit of the great western range of hills in Ceylon, at this point attaining a height of about 6000 feet.

It gives me great pleasure to name this curious form after its discoverer, Mr. Ernest E. Green, to whom entomology is greatly indebted for his accurate observations on the habits and careful delineation of the structure of the insect fauna of Ceylon.

BIBLIOGRAPHICAL NOTICES.

A Manual of North-American Birds. By ROBERT RIDGWAY. Illustrated by 464 outline-drawings of the generic characters. Second Edition. Philadelphia: J. B. Lippincott & Co., 1895. 1 vol., large 8vo, 653 pp.

RIDGWAY'S 'Manual of North-American Birds' has proved such a boon to working ornithologists that we gladly welcome a second edition, in which the work is brought up to date and all additions to the North-American avifauna since 1887 are included. The work was, we may remark, originally projected by the late Professor Spencer F. Baird, whose portrait forms the frontispiece to both editions, and was completed by Mr. Ridgway, his pupil; and the magnificent collections of North-American birds and eggs in the National Museum at Washington have been utilized in the descriptions given of the various species and subspecies. In the first edition four new genera were proposed and thirty-nine species and subspecies described as new, to which are added in the present edition two subgenera, *Oreospiza* (type *Fringilla chlorura*, Aud.) and *Arremonops* (type *Embernagra rufivirgata*, Lawr.), and ninety-one species and subspecies, chiefly the latter, as is the case in most American ornithological publications of the present day, for the number of the former amounts only to nineteen, all the rest being subspecies.

The main portion of the work differs but little from the first edition, even the original pagination having been retained, the alterations consisting chiefly of revision of the specific names; and the new species and subspecies are all given in the Appendix, except in the case of twelve, which were included in the analytical keys, where it was only necessary to change the typography of the names and prefix the catalogue-number of the American Ornithologists' Union's 'Check-list of North-American Birds.' Consequently the new matter is almost entirely confined to the Appendix.

Three species are expunged from the list—*Æchmophorus Clarkii*, as being almost certainly only the female of *Æ. occidentalis*; *Synthliboramphus wumizusume*, as not belonging to the North-American avifauna; and *Dolichonyx oryzivorus albinucha*, as being a bad subspecies. Amongst the species added to the list since the publication of the last edition are several game-birds which have been introduced, viz. *Tetrao tetrix*, which has been introduced into Newfoundland and is said to be naturalized there; *Chrysolophus pictus* and *Gennæus nychthemerus*, which have been introduced into Western Oregon; and *Chrysolophus Amherstiae*. *Numenius arquata* is included as having been said to have been taken on Long Island, and *Falco tinnunculus* is also added, but it is not stated on what ground. Our European Cuckoo, *Cuculus canorus*, is included as a subspecies (*Cuculus canorus telephonus*), and is said to occur accidentally on

St. Paul's Island, Bering Sea. Four subspecies of Shore-Larks are added, but with the exception of one, viz. *Otocoris alpestris insularis*, Towns., which is resident in the islands of San Nicolas, San Clemente, Santa Cruz, and Santa Rosa, Southern California, these are included in the Brit. Mus. Cat. of Birds (vol. xiii.). Of the numerous species and subspecies added to the North-American list only one species, *Megascops hastatus* (p. 593), from the vicinity of Mazatlan and possibly from Lower California, and one subspecies, *Cardinalis cardinalis floridanus* (p. 606), from Florida, are described as new; but a considerable number are not included in the 'Catalogue of Birds in the British Museum,' besides those already mentioned, viz.:—*Tympanuchus americanus Attwateri* (Bendire, 'Forest and Stream,' xi. no. 20, p. 425, 1893); *Megascops asio cineraceus* (Ridgway, 'Auk,' xii. p. 390, 1895), from North-western Mexico and contiguous portion of the U.S.; *Megascops asio Aikeni* (Brewer, 'Auk,' viii. p. 390, 1895), from the eastern foothills of the Rocky Mountains in Colorado and New Mexico; *Megascops asio Macfarlanei* (Brewster, *tom. cit.* p. 140), from between the eastern slope of the Cascade Mountains and the western slope of the Rocky Mountains in Oregon, Washington, Idaho, and Montana; *Megascops asio saturatus* (Brewster, *tom. cit.* p. 141), from the shores and islands of Puget Sound &c., north to Vancouver Island, New Westminster, and Comox, south along the coast to Portland, Oregon; *Megascops flammeolus idahoensis* (Merriam, N.-Am. Fauna, no. 5, p. 96, pl. i., 1891), from the mountains of Idaho; *Glaucidium Hoskinsii* (Brewster, 'Auk,' v. p. 136, 1888), from the mountains of southern Lower California; *Melanerpes formicivorus aculeatus* (Mearns, 'Auk,' vii. p. 249, 1890), from Western Texas to Arizona, and south through mountainous parts of North-west Mexico; *Contopus Richardsonii peninsulæ* (Brewster, 'Auk,' viii. p. 144, 1891), from southern Lower California; *Empidonax cineritius* (Brewster, 'Auk,' v. p. 90, 1888), from Lower California and North-western Mexico, south to Mazatlan; *Empidonax griseus* (Brewster, 'Auk,' vi. p. 87, 1889), from Lower California and Western and Central Mexico, Southern Arizona; *Aphelocoma californica obscura* (Anthony, Proc. Cal. Ac. Sci. 2nd ser. ii. p. 75, 1889), from the San Pedro Mountains, Lower California; *Spinus tristis pallidus* (Mearns, 'Auk,' vii. p. 244, 1890), from Arizona; *Pooecetes gramineus affinis* (Miller, 'Auk,' v. p. 404, 1888), from Western Oregon; *Ammodramus Henslowii occidentalis* (Brewster, 'Auk,' viii. p. 145, 1891), from Dakota; *Ammodramus caudacutus subvirgatus* (Dwight, 'Auk,' iv. p. 233, 1887), from the marshes of southern New Brunswick, Prince Edward Island, and probably Nova Scotia, and southward in migration along the Atlantic coast to South Carolina; *Ammodramus maritimus peninsulæ* (Allen, 'Auk,' v. p. 284, 1888), from the west coast of Florida; *Ammodramus maritimus Sennettii* (Allen, 'Auk,' v. p. 286, 1888), from the coast of Texas; *Junco hyemalis Thurberi* (Anthony, 'Zoe,' i. p. 238, 1890), from the mountains of California; *Junco hyemalis pinosus* (Loomis, 'Auk,' x. p. 47, 1893), from the

vicinity of Monterey, California; *Junco Townsendi* (Anthony, Proc. Cal. Ac. Sci. 2nd ser. ii. p. 76, 1889), from the San Pedro Mountains, Lower California; *Amphispiza Belli cinerea* (Townsend, Proc. U. S. Nat. Mus. xiii. p. 136, 1890), from Ballaenas Bay, Lower California; *Melospiza fasciata graminea* (Townsend, *tom. cit.* p. 139, 1890), from Santa Barbara Island, California; *Melospiza fasciata clementiae* (Townsend, *tom. cit.* p. 139, 1890), from San Clemente and Santa Rosa Islands, California; *Melospiza fasciata rivularis* (Bryant, Proc. Cal. Ac. Sci. 2nd ser. i. p. 197, 1888), from the mountain districts of Lower California; *Melospiza Lincolnii striata* (Brewster, 'Auk,' vi. p. 89, 1889), from the coast district of British Columbia; *Pipilo fuscus senicula* (Anthony, 'Auk,' xii. p. 111, 1895), from Southern California and Lower California as far south as 29° at least; *Cardinalis cardinalis canicollis* (Chapman, Bull. Am. Mus. N. H. iii. no. 2, p. 324, 1891), from South-western Texas south into North-eastern Mexico; *Pyrrhuloxia sinuata Beckhama* (Ridgway, 'Auk,' iv. p. 347, 1887), from Southern Arizona, New Mexico, and contiguous portion of Northern Mexico; *Pyrrhuloxia sinuata peninsulæ* (Ridgway, *ut supra*), from Southern Lower California; *Progne subis hesperia* (Brewster, 'Auk,' vi. p. 92, 1889), from Southern and Lower California; *Vireo solitarius lucasanus* (Brewster, 'Auk,' viii. p. 147, 1891), from Lower California; *Vireo Huttoni obscurus* (Anthony, 'Zoe,' p. 307, 1890), from Oregon to Vancouver Island and the mainland of British Columbia, south to California in winter; *Helminthophila celata sordida* (Townsend, Proc. U. S. Nat. Mus. xiii. p. 139, 1890), from San Clemente Island, California; *Dendroica æstiva sonorana* (Brewster, 'Auk,' v. p. 137, 1888), from Southern Arizona, Western Texas, and Sonora, Mexico; *Geothlypis trichas ignota* (Chapman, 'Auk,' vii. p. 11, 1890), from Florida and Southern Georgia; *Geothlypis poliocephala Ralphi* (Ridgway, Proc. U. S. Nat. Mus. xvi. p. 692, 1893), from the Lower Rio Grande Valley; *Harporhynchus cinereus Mearnsi* (Anthony, 'Auk,' xii. p. 53, 1895), from Western Lower California; *Heleodytes brunnei-capillus Bryanti* (Anthony, 'Auk,' xi. p. 212, 1894), from Western Lower California; *Thryothorus ludovicianus lomitensis* (Sennett, 'Auk,' vii. p. 58, 1890), from the Texan side of the Lower Rio Grande; *Thryothorus leucophrys* (Anthony, 'Auk,' xii. p. 52, 1895), from San Clemente Island, California; *Cistothorus palustris Marianeæ* (Scott, 'Auk,' v. p. 188, 1888), from the salt-marshes of Western Florida; *Cistothorus palustris griseus* (Brewster, 'Auk,' x. p. 216, 1893), from the coast of South Carolina to Northern Florida; *Sitta carolinensis Atkinsi* (Scott, 'Auk,' vii. p. 118, 1890), from Florida; *Sitta pygmæa leuconucha* (Anthony, Proc. Cal. Ac. Sci. 2nd ser. ii. p. 77, 1889), from the San Pedro Mountains, Lower California; *Parus carolinensis agilis* (Sennett, 'Auk,' v. p. 46, 1888), from Bee, Victoria, and Concho Counties, Texas; *Parus hudsonicus Stoneyi* (Ridgway, Man. N.-Am. B. p. 591, 1887), from the Kowak River, Alaska; *Parus hudsonicus columbianus* (Rhoads, 'Auk,' x. p. 23, 1893), from the Rocky Mountains, from the Liard River south into

Montana; *Psaltiparus santarite* (Ridgway, Proc. U. S. Nat. Mus. x. p. 697, 1887), from the Santa Rita Mountains, Southern Arizona; *Psaltiparus Lloydi* (Sennett, 'Auk,' v. p. 43, 1888), from the mountains of Western Texas, between the Pecos and Rio Grande; *Regulus satrapa aztecus* (Lawrence in MS.), from the high mountains of Central Mexico; *Poliophtila caerulea obscura* (Ridgway, Proc. U. S. Nat. Mus. v. p. 535, footnote, 1883), from California, Arizona, &c., and Western Mexico; *Sialia mexicana Bairdi* (Ridgway, 'Auk,' xi. pp. 151-157, 1894), from the Rocky Mountains and south into Northern Mexico; and *Sialia mexicana Anabelæ* (Anthony, Proc. Cal. Ac. Sci. 2nd ser. ii. p. 79, 1889), from the San Pedro Mountains, Lower California.

The plates, containing the outline-drawings of the generic characters, are the same as in the first edition, no alteration or addition having been made. Not a little of the nomenclature will scarcely be adopted in Europe, and some of the subspecies appear to be founded on very trifling differences, at least according to our perhaps somewhat old-fashioned views; but the work is one of extreme utility to working ornithologists, and will no doubt be universally adopted in America as the standard work on the subject.

A Concise Handbook of British Birds. By H. KIRKE SWANN.
London: John Wheldon & Co., 1896.

JUDGING from the number of works that have recently been published, varying in quality from Lord Lilford's beautifully illustrated 'Coloured Figures of British Birds' to the work on the Birds of Great Britain in sixpenny parts that is to be seen on almost every railway bookstall, the study of ornithology certainly appears to be on the increase in Great Britain. The last work on the subject that we have received is a handy little manual of British Birds by Mr. H. Kirke Swann, small enough to be carried in the pocket, containing short particulars of the habitat, descriptions of the male and female, and notes on the range in Great Britain, and, in the case of the commoner species, a description of the nest and eggs and short particulars of the habits. Of some of the rarer species a short description is given, but of most of these none is vouchsafed, which appears to us to be a mistake, as a short diagnosis to enable a collector to identify any rare straggler that he might obtain would occupy but little space and would add considerably to the utility of the work. Some bad species have been admitted, as, for instance, *Anthus rupestris*, *Parus Dresseri*, and *Troglodytes hirtensis*, the two latter of which, by the way, are treated only as subspecies, and several American stragglers, such as *Elanoides furcatus*, *Querquedula discors*, and *Querquedula carolinensis*, are included on very insufficient grounds. The range of *Turdus torquatus* is given as extending to the south of Europe, whereas in the mountain ranges of southern

Europe it is replaced by a closely allied but specifically distinct race, *Turdus alpestris*. For the Linnet and Redpolls the genus *Canina* is adopted, which is, we think, wrong, as *Linota* is the correct generic title for this group.

The author says in the Preface that "the classification and nomenclature practically accord with those of the 'List of British Birds' compiled by a committee of the British Ornithologists' Union, but a number of necessary alterations have been made"; and we think it would have been much better if he had followed that list more closely than he has done. In the first case the adoption of the so-called *Scomber-scomber* principle is a mistake, as pointed out in the 'Ibis' (1894, p. 566, and 1895, p. 168), and is in direct opposition to the Stricklandian code and the B. O. U. Committee. But Mr. Swann does not, we perceive, adopt this principle all through, as he calls the Hawfinch *Coccothraustes vulgaris* and the Goldfinch *Carduelis elegans* and not *Coccothraustes coccothraustes* and *Carduelis carduelis*. It is a pity also that trinomialism has been introduced into this work, as it is, we hold, not calculated to simplify matters and has not taken root, here in England at least, and seems out of place in a work which is especially adapted for use by the general public and not by scientific ornithologists.

On the whole, however, the work is one calculated to be of use to the small collector, being handy in size, well up to date, and well within the means of small collectors as regards price, but would, we think, prove more useful were it subjected to some alteration and revision.

MISCELLANEOUS.

On the Habitat of Gobius elapoides, Gthr.

To the Editors of the 'Annals and Magazine of Natural History.'

GENTLEMEN,—When Dr. Günther (Proc. Zool. Soc. Lond. 1871, p. 665, pl. lxiii. fig. D) gave the description and figure of this beautiful and highly interesting *Gobius* he could not certify its habitat, only supposing that it inhabits some part of the coasts of the Japanese regions. It may thus be worth noticing that the Museum of Upsala has received a specimen, length 83 millim. (68 millim. without caudal fin, from the tip of the snout to the front margin of the last transverse dark brown band), that was taken by Captain Svensson at St. John's Island, 90 miles east of Hongkong.

Yours truly,
F. A. SMITT.

Stockholm,
July 7, 1896.

Note on Plectroplites and Hypoplectrodes, Genera of Serranoid Fishes. By THEODORE GILL, LL.D.

Mr. Boulenger, in the first volume of his excellent 'Catalogue of the Perciform Fishes,' has accepted two later names for genera on account of imperfect data respecting earlier ones: these are *Ctenolates* instead of *Plectroplites* and *Gilbertia* in place of *Hypoplectrodes*. It is not surprising, for the author himself had even forgotten one — *Hypoplectrodes*.

I.

The name *Ctenolates* of Günther (1871) was adopted by Mr. Boulenger, and as a synonym was noted "*Plectroplites*, Gill, Proc. Ac. Philad. 1862, p. 236 (no definition); Bleek. Arch. Néerl. xi. 1876, p. 267."

It is true that at the place cited by Mr. Boulenger "no definition" was given, but one was supplied later in the following terms:—

"The *Datnia*? *ambigua* of Richardson, which has been referred by Günther to the genus *Dules*, differs from *Moronopsis** by the shorter convex anal fin, the large second anal spine, the small eyes, and the entire physiognomy. It may be called *Plectroplites ambiguus*."

The characters thus positively given and contrasted with those of *Kuhlia* or *Moronopsis* are sufficient to differentiate and define the genus, although the author, like Günther and all others, was unaware of the trenchant anatomical characters further differentiating the genus from *Kuhlia*. The synonymy of the genus should be amended as follows:—

Genus PLECTROPLITES.

Plectroplites, Gill, Proc. Acad. Nat. Sci. Philad. 1862, p. 236 (with typonym only), 1863, p. 286 (defined).

Ctenolates, Günther, Proc. Zool. Soc. 1871, p. 320.

Datnia? sp., Richardson.

Dules, sp., Günther (1859) et al.

The *P. ambiguus* is still the only species known.

II.

The name *Gilbertia* of Jordan and Eigenmann was adopted by Mr. Boulenger † in place of *Hypoplectrodes*, because the latter was supposed to have "no definition." On the page referred to by Mr. Boulenger, indeed, no definition was given; but later (in 1871) Professor Poey, to whom I had indicated the characters in response

* *Moronopsis* had been previously named by Gill *Kuhlia*, and the latter name has been adopted by Jordan and Boulenger.

† Vol. i. p. 306.

to an inquiry for them, gave them in a memoir entitled "Genres des Poissons de la Faune de Cuba appartenant à la Famille Percidæ, avec une Note d'introduction par J. Carson Brevoort" *. Prof. Poey's diagnosis was as follows :—

"Le genre *Hypoplectrodes* a été proposé par Mr. Gill, Proc. Acad. Phil. 1862, p. 236, pour le *Pl. nigro-rubrum*, C. et V. Il est plus allongé que le *Pl. serratum*; les dentelures du bord montant du préopercule sont plus fines; il n'y a au bord inférieur que deux pointes dirigées en avant, dont l'une à l'angle. D. 10, 17; A. 3, 8."

I have to confess that I myself had forgotten having named this genus, or, at least, failed to connect with it the *Plectropoma Huntii* of Hector of New Zealand, and consequently adopted the name *Gilbertia* of Jordan and Eigenmann, who had overlooked the previous proposition of the genus by Gill and Poey.

The facts of the case, then, are expressible in the following synonymy :—

Genus HYPOPLECTRODES.

Hypoplectrodes, Gill, Proc. Acad. Nat. Sci. Philad. 1862, p. 236 (with typonym only) (1862); Poey, Ann. New York Lyc. Nat. Hist. x. p. 45, 1871 (defined).

Gilbertia, Jordan and Eigenmann, Bull. U.S. Fish Comm. viii. p. 346 (1890).

The species of *Hypoplectrodes*, according to Mr. Boulenger's † views, are four in number, viz. :—

1. *H. semicinctus* = *Plectropoma semicinctum*, C. V. = *P. Huntii*, Hector.
South Australia, New Zealand, Chile.
2. *H. annulatus* = *Plectropoma annulatum*, Günther.
South Australia.
3. *H. nigroruber*.
South Australia.
4. *H. (?) armatus* = *Serranus armatus*, Castelnau.
Australia (Swan River).

It may be added that the name *Gilbertia* was also given in 1891 ‡ by Lord Walsingham to a genus of Pterophoroid Lepidopters.—*Proc. U.S. Nat. Mus.* vol. xviii. no. 1082, pp. 567, 568.

* 'Annals of the Lyceum of Natural History of New York,' x. pp. 27-79.

† Vol. i. pp. 306-309.

‡ Ent. Monthly Mag. (2) ii. p. 259.

On the Nephridia of Branchiobdella varians (var. astaci). By D. N. VOINOV, Morphological Laboratory at Bucharest.

During the year 1895 I have studied the excretory apparatus of *Branchiobdella varians* (var. *astaci*), a parasite which I have found in great quantities occasionally upon the branchiæ of crayfish brought to the market of Bucharest.

Despite the labours of Henle, Keferstein, Dorner, Lemoine, Voigt, &c. on the general organization of this animal, the excretory organ is still insufficiently understood. All that was known was that each nephridium is composed of five regions, which are from within outwards:—(1) the vibratile funnel; (2) the red gland (of Odier); (3) the canalicular chain; (4) the excretory canal (effluent); (5) the terminal vesicle. The structure and true relation of these various parts were, however, unknown; in a word, no general interpretation of this complicated organ has ever been given.

I have studied the excretory apparatus by transmitted light in the living animal and by means of microscopic sections; the results arrived at may be briefly summarized as follows:—

The funnel is composed of a body—the funnel properly so-called—and of a peduncle, which is a continuation of it. It is placed on the ventral side of the animal, and opens partly into the general cavity of the animal and partly into the red gland, with which it communicates by the peduncle. This first part of the nephridium is provided with a continuous ciliary covering, the movement of which is towards the red gland. The form of the funnel so-called is that of a cup with straight ciliated edges; its longitudinal diameter is 0.10 millim. and its greatest transverse diameter is 0.075 millim. The funnel and its peduncle are capable of movement in all directions in the interior of the cavity of the segment around their base of attachment.

The red gland of Odier is a lobulated body, of a red-brown colour in the adult animal. By reason of its structure and connexions I have named it *capsule*, after the name of the corresponding region in the nephridia of the Hirudineæ. In this gland there are to be distinguished two kinds of structures:—(1) a system of irregular lacunæ, communicating one with another, traversing it in all directions, and giving it a spongy appearance: (2) a system of regular canals. The former belong properly to the capsule, being excavated in its substance, whilst the latter only traverse it, establishing communication between the capsule and the third part of the nephridium, that is to say, the canalicular chain.

The peduncle of the funnel opens into a lacuna of the capsule. One of these lacunæ, greatly enlarged, contains in its interior a compact cellular mass, analogous to the contents of the capsule in the Hirudineæ, in which are gathered a quantity of pigmentary granules of a red-brown colour. The flagella are fixed to the walls of the lacunæ, turned in all directions, thus indicating a great complication in the direction of the movement of the lacunar fluid. In

the sections the capsule is seen to be divided into distinct lobes, pressed one against the other, showing that it is formed by a rolled-up canal, the walls of which have fused.

The canalicular chain corresponds with the region which German naturalists have named "Schleipenorgan" in the excretory apparatus of the Hirudineæ. It is traversed throughout its whole length by four canals, which communicate two and two, at its free extremity. This caused Lemoine (1880) to believe that it is formed by two pairs of united canals. In reality the direction of the current indicated by the flagella in the interior of these canals, as well as their relation to the canalicular structures of the capsule, oblige us to consider the "Schleipenorgan" as a single and distinct canal. After taking its origin in the lacunar system of the capsule, it is folded four times on itself, its faces of contact are fused together, and is continued into the excretory canal.

The communication one with another of these supposed four canals, as well as the continuation of the "Schleipenorgan" into the excretory canal, takes place in the capsule. Contrary to the assertions of the authorities previously cited, the internal cavity of the excretory canal is completely bare of vibratile cilia and flagella.

The terminal vesicle, oval in form, opens directly on the exterior by the excretory orifice; it has a longitudinal diameter of 80-90 μ in a state of extension. It is formed by an invagination of the integument. Its wall is made up of three successive layers, which are, from within out, an epithelial coat, clothed by a cuticle which represents the ectoderm; a middle muscular coat, formed by the circular fibres of the body-wall; and a delicate external membrane. There are no vibratile cilia in the interior.

The excretory apparatus of *Branchiobdella* has the same structure as the corresponding apparatus in the Hirudineæ, and appears to be of an intracellular character; the protoplasm presents around the cavities well-marked radial striations. The nuclei are distributed in its interior, but no limiting membrane of the cellular masses exists.

The whole surface of the nephridium is enveloped in the peritoneum, which constitutes ligaments and exhibits in certain places large granular peritoneal cells.

I have made no direct experiments to determine the physiological rôle of the nephridia of *Branchiobdella* (I propose to attack this question shortly), but observations made upon the living animal enable me to assert that, besides liquid excreta, these organs absorb solid matters. These latter arise from the breaking down of the chloragogenic cells, detached from the intestine, and of too large a size to penetrate into the vibratile funnel. I have never seen solid bodies in the interior of the "Schleipenorgan" nor in the terminal vesicle. The solid particles which have penetrated through the funnel are stopped in the capsular lacunæ, where probably they are destroyed. It is possible that the accumulation of pigment in the cellular mass, which I have described, in the capsule arises from this destruction.—*Comptes Rendus*, 1896, t. cxxii. pp. 1069-1071.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 105. SEPTEMBER 1896.

XXXII.—*Notes on the Chaetognaths.* By F. S. CONANT*.

THE following notes are based in part upon observations made at Beaufort, N. C., during the summer of 1895, and in part upon later work on preserved material. That which concerns the egg-laying rests wholly on one form, *Sagitta hispida*, a species very much like the *Sagitta bipunctata* of European writers, which was described by me in the 'University Circular' for June 1895 (no. 119)†. With the exception of *Sagitta hispida* and another form, *Spadella schizoptera*, described in the same article, the Chaetognaths of American waters have not been subjected to the European standards of classification, and in the systematic part of this paper an attempt has been made to describe, as accurately as alcoholic material would allow, such of the American Chaetognaths as have come into the writer's hands.

I. EGG-LAYING.

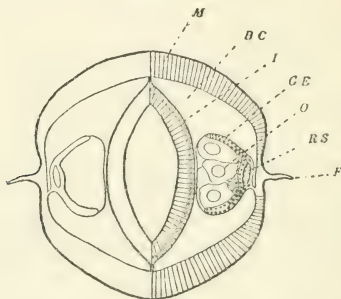
So far as is revealed by a search of the literature, the passage of the ova into the oviducts has not been actually

* From the 'Johns Hopkins University Circulars' for June 1896, pp. 82-85.

† Reprinted in the 'Annals' for 1895, vol. xvi. p. 288.

observed heretofore. The structure of the ovaries is such that no direct course is offered to the exterior, and it has been a matter of some speculation with the authors how the eggs do get into the ducts. The ovaries are two bilateral cylindrical bodies situated in the posterior part of the body-segment. Along the outer edge of each there extends a duct, which opens to the exterior laterally at the level of the posterior end of the ovary. This is called by Hertwig * the oviduct. By Grassi †, since it is very often found to contain spermatozoa, it is called the "ovisperm duct." A glance at fig. 1, which represents a cross section through the body of *Sagitta hispida*

Fig. 1.



Cross section of *Sagitta hispida*, with eggs still in the ovary. *M*, muscle; *BC*, body-cavity; *I*, intestine; *GE*, germinal epithelium; *O*, ovarian eggs; *RS*, receptaculum seminis; *F*, lateral fin.

in the region of the ovaries, will show that the ova are separated from this duct by a layer of cells of the germinal epithelium. This extends between the ova and the duct throughout, and leaves no clearly marked communication, through which the eggs might pass, at either the anterior or the posterior end of the ovary. Hertwig supposes that the eggs pass into the duct near its opening posteriorly, being probably pressed through the intervening germinal epithelium. He concludes:—"Ist meine Deutung richtig, so würde nur das hintere Ende des Oviducts zur Ausführung der Eier dienen, und gleichzeitig den Ort abgeben, wo die Befruchtung erfolgt, dagegen würde der grössere blind geschlossene Theil des

* "Die Chaetognathen," *Jenaische Zeitschr.* Bd. xiv. (1880).

† 'Fauna und Flora d. Golfes von Neapel,' no. 5 (1883).

Oviducts als eine Art Samentasche functioniren, wie der oft in ihr vorgefundene Inhalt lebender Spermatozoen beweist."

Grassi finds that the wall of the ovisperm duct is interrupted at irregular intervals, and that through these interspaces spermatozoa may pass into the ovary before the ova are mature, sometimes penetrating the unripe ova and causing degenerative changes. These interruptions in the wall exist along the whole length of the duct, and Grassi thinks that probably the ova make their way through them into the duct, thus passing into the duct anywhere throughout its length.

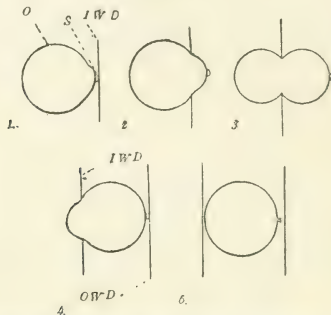
I may say, in brief, that while my preparations show nothing of these interruptions in the wall of the duct, the actual course of events points to the correctness of Grassi's supposition that the ova pass through some such interspaces. They do not, however, appear to pass into the "ovisperm duct," but into another entirely new channel. The "ovisperm duct" seems to function, at least throughout all but the posterior part of its course, as a receptaculum seminis, and Hertwig's supposition is found true in this regard.

Sagitta hispida, which is found in abundance at Beaufort, offers a favourable opportunity for the study of the passage of the ova into the oviduct in the living object. With this species the egg-laying occurs at about sunrise, as is stated also by Grassi for the Mediterranean form *Sagitta hexaptera*. Boveri quotes Fol as finding the eggs of *Sagitta bipunctata* laid at sunset; and he found the same himself in March, but the process was often much delayed, so that at times he waited till 11 or 12 o'clock in vain. The exact time with *S. hispida* is found to depend somewhat upon the temperature. While the eggs were generally laid about 5 o'clock in July and August, on a cooler morning than usual the process might be found to occur an hour later; and by artificial cooling in an ice-chest overnight the laying might be delayed as much as three hours. Such artificially retarded eggs developed regularly on the whole, but it was found safer to make the observations at the earlier normal hour.

To follow the process, then, the eggs are found in the ovary the first thing in the morning—at 5 o'clock in the case that we will select—with the large germinal vesicle still showing, but lying eccentrically toward the mid-line of the animal. By 5.16 the germinal vesicles have entirely disappeared. At 5.22 each egg has flattened somewhat from before backward, and a small cell is seen clearly at the outer end opposite the point where the germinal vesicle was. The ova of the *Chaetognaths* arise from the germinal epithelium on stalks (see Grassi, Taf. xi. figs. 9 and 10), and the small cell standing

out plainly in the living object at this stage is found in sections to be the stalk-cell, which thus precedes the ovum in its passage into the duct. The ovum itself now changes its spherical shape by sending out a projection, bearing the stalk-cell, into the duct. Then by a progressive series of changes in shape, such as is represented in fig. 2, each ovum makes

Fig. 2.



Diagrams illustrating the successive stages of constriction in the passage of an egg into the oviduct. *O*, ovum; *S*, stalk-cell; *IWD*, inner wall of the oviduct; *OWD*, outer wall

its way into the oviduct. It is evidently passing through some such interspace in the wall of the oviduct, as was supposed by Grassi. The process occupies about eight or ten minutes. All the ova of one side pass through the successive stages of constriction at essentially the same time, the anterior being slightly in advance of the posterior. There may be a difference of time, however, between the ova of the two sides.

The eggs remain in the oviduct from twenty minutes to half an hour before being laid, during which time the layer of gelatinous substance that surrounds each is thickened. The chief change, however, is a gradual compression of the eggs from before backward, so that they become ellipsoidal. The process is aided by contractions of the ovary, especially observed at the anterior end, and as a result the eggs are pushed backward toward the external opening. When the pressure has become great enough to overcome the resistance, which seems to be offered largely by a kind of mucous plug in the orifice, the eggs are extruded as two linear rows, one from each oviduct, the whole comprising anywhere from a few to sixty or seventy eggs.

The act of laying was seen by Boveri * in *S. bipunctata*. After describing the way in which the eggs were extruded, simultaneously from both sides and very quickly, with active movements of the animal, he adds:—"Wobei dieselben um die enge Austrittsöffnung zu passiren aus ihrer kugeligen Form in eine gestreckte Wurstform übergangen, die im Wasser allmählich zur Kugelgestalt zurückkehrte." This description applies perfectly to *S. hispida*, the "Wurstform," however, being first produced by the crowding of the eggs in the duct, and afterwards increased by the passage through the narrow orifice. The orifice is at right angles to the main axis of the duct, so that the crowding has the result of presenting the eggs with their longest diameter in the direction of the orifice.

It has already been mentioned that the so-called ovisperm duct, into which the eggs apparently pass, is found to contain spermatozoa, and the inference would be that the eggs pass into the mass of spermatozoa and are there fertilized. I found last summer that soon after the eggs begin the process of constriction the previously active movements of the spermatozoa cease; that after the complete passage into the oviduct the spermatozoa are held, as it were, congealed in a longitudinal streak external to the eggs; that when the eggs are laid there is no noticeable diminution in the number of spermatozoa, and that their active movements are later resumed. This suggested that the passage was not into the "ovisperm duct," and sections of material preserved at these stages confirmed the supposition. Fig. 3 shows that the spermatozoa are kept in the "ovisperm duct" (*RS*) apart from the ova, and that the latter have made their entrance into a new and apparently temporary channel between the germinal epithelium and the epithelium of the "ovisperm duct." The latter is therefore only a receptaculum seminis, as Hertwig supposed. It may be objected that the spermatozoa are, as it were, sealed up by a secretion of mucus about them, and that this, in the hardened material, gives the appearance of a membrane; but the occurrence of nuclei seems to show that the structure is a definite one. The walls of the oviduct did not show any such nuclei, and the existence of an epithelial lining in it is doubtful.

Of course the foregoing applies only to *S. hispida*, and cannot be at once assumed to be the case in all *Chaetognaths*. It is probably the case, however, for *S. hispida* is a very typical form. *Spadella schizoptera* offers some collateral

* 'Zellen-Studien,' Heft iii. 1890, p. 18.

evidence ('Circular,' no. 119, June 1895). In this form it was found that the two "ovisperm ducts" were united by a transverse branch, a structure that would seem to have no significance in an oviduct, but would be extremely useful in uniting two receptacula seminis, inasmuch as a single copulation, affecting only one side, would thereby serve to fertilize the ova of both sides.

It would seem, then, that the female reproductive system of *S. hispida* (and, perhaps, all *Chaetognaths*) consists on each side of the ovary, the receptaculum seminis, and a temporary oviduct lying parallel and internal to the receptaculum and uniting with it posteriorly to open on a common genital

Fig. 3.

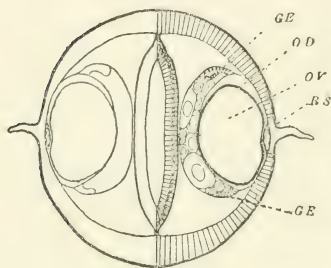


Fig. 4.

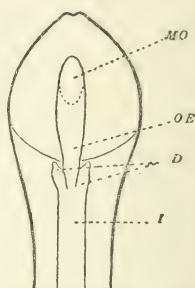


Fig. 3.—Cross section of *Sagitta hispida*, with eggs in the oviduct, before laying. GE, germinal epithelium; OD, oviduct; OV, ovum; RS, receptaculum seminis.

Fig. 4.—Diagrammatic optical section of the head and neck of *S. hispida* from above. MO, mouth; OE, œsophagus; D, diverticula; I, intestine.

papilla. A more detailed account of the histology of these structures could be given were it not that the *Chaetognaths* offer such very unfavourable material for the study of microscopic anatomy. Kleinenberg's picro-sulphuric, Perenyi's, and corrosive acetic give the best results; but even with them the objects are very unsatisfactory, and especially so during the processes of egg-laying, when the tissues are evidently being subjected to great stress.

The exact point at which the spermatozoa come in contact with the eggs I have not been able to determine. Grassi says that spermatozoa can pass into the ovary, where he has found them; but he does not state that fertilization occurs

here normally. In agreement with Hertwig, I have never found spermatozoa in the ovary. Neither do the eggs appear to be fertilized in the oviduct. Before they pass out of the ovary a number of very small chromosomes (the exact number was not determined) are found toward the inner end of the ovum, or the place where the germinal vesicle disappears. During the twenty to thirty minutes that the eggs are in the oviduct before being laid there are no changes in these bodies, and they continue to be the only chromatin that I am able to find in the egg until after the laying. The probability is, therefore, that the spermatozoa come in contact with the eggs, shortly before or during the process of laying, in the duct to the exterior common to the oviduct and receptaculum seminis.

Self-fertilization seems to be impossible, although the male and female elements develop at the same time. In the case of a *S. hispida* isolated when the ovaries contained only immature ova, I found that by the second morning 30 or 40 eggs had matured and been laid, on the third 24 more, on the fifth 68, on the seventh 55-58. Of these the only ones that developed were fourteen out of the first lot, evidently fertilized by spermatozoa remaining in the receptaculum seminis. In all the others development proceeded only so far as the formation of the polar bodies. In this case the extrusion of the polar bodies is evidently not dependent upon the entrance of the spermatozoa, which Boveri states is necessary in the ova of *S. bipunctata* observed by him.

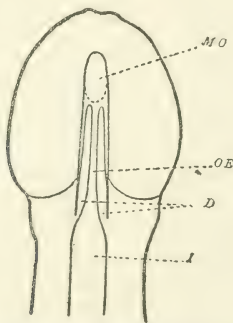
The eggs when laid become attached to the sides of the dish by a gelatinous or mucilaginous substance, which facilitates handling somewhat, but also collects dirt. The development of the young *Sagittae* up to hatching is completed in about thirty-six hours in warm weather. When hatched they have practically the adult structure, and in four or five days they are found to eat each other with as much zeal as is shown by their elders in the same performance. It is interesting to watch a *Sagitta*, with a relatively narrow digestive tract two thirds the length of its body, forcing down its oesophagus a fellow of equal size, and hence one third longer than the tract. The eating one another seems to be done purely out of natural depravity, for it occurs when plenty of the usual food, small tow-stuff, is present.

Upon the development of the eggs I have nothing to add. Like the previous observers, I have been unable to find a satisfactory method of preservation, in spite of many trials.

II. THE DIVERTICULA OF THE INTESTINE.

In two of the European species, *Sagitta minima* and *Spadella cephaloptera*, a pair of diverticula are described as occurring at the anterior part of the intestine. In the American forms this structure is more common, being found in three of the nine species about to be enumerated. In *S. hispida* they appear from the surface as outlined in fig. 4. A cross section through the animal in this region would show the digestive tract composed of three tubes lying side by side, as figured by Grassi for *Spadella cephaloptera* (Taf. vi. fig. 11), of which the middle one is in reality only the œsophagus, as it enters the stomach intestine. The epithelium of the diverticula is the same as that of the intestine, and they seem to be in fact only the prolongations of the intestine anteriorly beyond the point where the laterally compressed œsophagus makes connexions with it. In a variety of *S. hispida* from the Bahamas the diverticula are reduced to a very small size, and cannot have much function. In the Beaufort *hispida* and in *S. elegans* they may vary according to the individual—in some large, in some small.

Fig. 5.



Diagrammatic optical section of the head and neck of *S. elegans* from above. *MO*, mouth; *OE*, œsophagus; *D*, diverticula; *I*, intestine.

An interesting modification of apparently the same structure occurs in *S. elegans*. In many of the specimens from Woods Holl diverticula are found extending *within* the digestive tract. Fig. 5 gives a diagrammatic representation of these

structures. A cross section in this case would show a large tube—the œsophagus—enclosing two smaller yet relatively large tubes—the diverticula. The latter bear on the surface that is turned toward the digestive tract an epithelium like that of the rest of the tract, and they thus represent exactly the structure that might be produced by pushing external diverticula back upon themselves into the digestive tract. Much careful examination failed to reveal any specific differences between the animals having external and those having internal diverticula. It may be that observation of living specimens, however, would show that we have here two species. There is a possibility also that the two forms are different phases of the same structure in one and the same animal; but this seems to me improbable. Some specimens having internal diverticula show a formation at the base of these suggestive of external diverticula as well.

The function of such internal diverticula can hardly be surmised. The lumen, which is connected with the body-cavity, is often found to contain coagulated coelomic fluid. What strikes one most prominently, however, is that they would seem of necessity to be very much in the way in the act of swallowing.

III. CLASSIFICATION.

In May 1895 E. Béraneck published in the 'Revue Suisse' (tome iii. fasc. 1) an article entitled "Les Chétognaths de la Baie d'Amboine," in which he devoted several pages to a critical review of the systems of classification. After comparing the defects in the classifications of Langerhans (followed by Strodtnann* in 1892), Hertwig, and Grassi, he came to the conclusion that the first offers the most advantages in our present state of knowledge.

At about the same time ('University Circular,' June 1895) I was having difficulty in finding a place for *Spadella schizoptera* in any of the systems. It seemed to me that Grassi's classification met the case the most satisfactorily, except that he unfortunately interchanged the names of his two genera, so that his *Spadella* very nearly represented the *Sagitta* of other authors.

Now, however, having seen Béraneck's paper and having studied more forms, I am inclined to admit the full weight of the arguments against Grassi's system. Dividing a group of animals into two genera, one characterized by certain features

* Archiv für Naturgesch. lviii. (1892).

and the other by the absence of those features, is of itself enough to condemn the system. But at the same time it seems to me that Grassi's objections to the system of Langerhans, as based upon structures of such slight morphological importance as the fins and teeth, are equally sound. Yet the classification of Langerhans is very convenient, and on this account, and because it has been adopted by the last writers on the *Chætognaths*, I have followed it, except in one case—in the systematic portion that is appended. But that it, as well as the others, is unsatisfactory, can be readily shown by instances from the American species, in addition to the cases given by Béraneck.

For example, *Spadella schizoptera*, according to Langerhans and Hertwig, would be called a *Sagitta* on account of its five fins; only Grassi's system would retain it with the closely related *Spadella cephaloptera*.

Spadella maxima in the classification of Langerhans would belong to the genus *Krohnia* or to the genus *Spadella*, according as the fins or the teeth were accounted the more important; for its one pair of lateral fins lies partly on the trunk, partly on the caudal segment (*Krohnia*), while the teeth are in two series (*Spadella*). According to Grassi, it would probably be placed in his genus *Spadella* (*Sagitta* of the others), for none of his characteristics for the genus *Sagitta* (*Spadella* of the others) was found in the specimens studied. And yet in its coloration and in its habitat near the bottom it is evidently allied, notwithstanding its size, to the small *Spadellæ*.

By Langerhans *Krohnia hamata* is set apart with one other species to form a genus by themselves, characterized only by the fact that in connexion with one part of lateral fins there is but one series of teeth. According to Hertwig it is included with the *Spadellæ*, notwithstanding its free-swimming life at the surface. According to Grassi it would probably be included with the *Sagittæ* (his *Spadellæ*), although the form studied by me showed the transverse musculature that is a characteristic of the *Spadellæ* (his *Sagittæ*).

These cases are additional proof that none of the divisions of the *Chætognaths* into genera is satisfactory; while for convenience' sake and from deference to the later writers I have followed the classification of Langerhans, it would perhaps have been as well to give up the distinctions *Spadella* and *Krohnia* altogether, and retain only the one genus *Sagitta*.

IV. SYSTEMATIC.

*The known Chaetognaths of American Waters.*1. *Sagitta elegans* (Verrill).

Strodtmann mentions this species (*loc. cit.*), but was unable to find a description of it in the literature at his command. Professor Verrill's account is found on page 332 [626] of the 'Report upon the Invertebrate Animals of Vineyard Sound and Adjacent Waters' (Washington, Government Printing Office, 1874).

S. elegans resembles the widespread *S. bipunctata*. The length of the largest specimens in my possession is 25–30 millim. Maximum breadth 1 millim. Caudal segment one fifth total length. Fins 5, like those of *bipunctata* or *hispida*. Seizing-hooks 9–12, shaped as in *bipunctata*. Anterior teeth 5–7. Posterior teeth 12–15. Corona ciliata elongated, sinuous, oval, as in *bipunctata* or *hispida*. Diverticula of intestine both external and internal, as described in the preceding. Accessory longitudinal septa present in caudal segment. Tactile prominences generally few as compared with *S. hispida* (see fig. 7 in 'Circular' for June 1895). Musculature of body not so stoutly developed as in *hispida*. Head well marked off from trunk. Epidermis thickened around the neck.

S. elegans differs from *bipunctata* in size, in the relative proportions of caudal and body-segments, and in the presence of diverticula from the intestine. It is found at Wood's Holl, Mass., in winter, sometimes in great abundance. In summer it is rare there. None of the many specimens that I have seen, taken in the winter months by Mr. Vinal Edwards, of the Fish Commission, contained mature ova.

The name *elegans* was applied by Professor Verrill to specimens 16 millim. long; he also mentions a "much larger and stouter species than the preceding, taken in abundance in Vineyard Sound from January to May, 25–30 millim. long." I have not been able to find any specific difference between the large and small specimens from Wood's Holl, and do not doubt that they are the same.

Strodtmann mentions a "*S. gracilis*," figured by Verrill in the "Results of the Explorations made by the Steamer 'Albatross' off the Northern Coast of the United States in 1883." Professor Verrill has very kindly replied to my inquiry in reference to this, that the figure is of *S. elegans*, the name "*gracilis*" being the result of a clerical error. The

large salmon- or orange-coloured form mentioned in the same article is the species next described.

2. *Spadella maxima*, sp. n.

Specimens of this and the two following species were given me by Professor Verrill from the 'Albatross' material in his possession, and I am indebted also to Dr. G. Brown Goode, of the National Museum, for permission to include them in this list.

Spadella maxima is an unusually large and stout Chætognath, 52 millim. long and 5 millim. wide. Its one pair of lateral fins extends along the posterior two thirds of the body-segment and the anterior third of the caudal segment. According to the classification followed by Strodtmann, therefore, it would belong to the genus *Krohnia*. The reasons for including it among the *Spadella*, which otherwise are, without exception, small animals, are found in the note on classification. Seizing-hooks 6. Anterior teeth 3-5. Posterior teeth 5-7. The corona could not be made out satisfactorily in the preserved specimens; it seemed to resemble the pear-shaped form found in *S. hexaptera*. No diverticula from intestine. Muscles slender in proportion to the breadth of the body, a large lateral area on each side between the dorsal and ventral bands being free from muscle. Epidermis thickened to several layers of cell around the neck.

The specimens had been in alcohol for some years and were entirely devoid of the "deep salmon- or orange-colour" mentioned by Professor Verrill as characterizing them from the colourless surface-forms. They were brought up in the trawl-wings at Station 2428 of the 'Albatross,' in the North Atlantic, lat. N. 42° 48', long. W. 50° 55' 30".

3. *Krohnia hamata* (Möbius).

Chætognaths evidently belonging to this species were taken in the trawl-wings at Station 2045, off Martha's Vineyard. They have one pair of very delicate lateral fins, hooks bent sharply at the tips, anterior teeth wanting, and a very large number of posterior teeth—all of which are characteristic of *K. hamata*. But they offer one unusual variation in the possession of a well-marked ventral sheet of transverse muscle, such as in Grassi's classification is characteristic of his genus *Sagitta* (*Spadella* of the others). It extends from the beginning of the neck as far back as the posterior edge of the abdominal ganglion.

4. *Sagitta hexaptera* (d'Orbigny).

From the same station as the preceding there are some specimens, 24-34 millim. in length, which do not differ enough from the *S. hexaptera* of European writers to warrant establishing a separate species. The caudal segment is one fourth to one fifth the total length. Fins 5. Seizing-hooks 7-8. Anterior teeth 3-4. Posterior teeth 4-7. Ovaries immature. The body-muscles are stouter than is stated for *hexaptera*, however, and the specimen sectioned showed two large external diverticula from the intestine. It is very possible that study of fresh material would show them to be a distinct species instead of young *hexaptera*.

5. *Sagitta flaccida*, sp. n.

This species was collected by Dr. Andrews at Bimini, in the Bahamas. Length 13-18 millim. Breadth 1.25 millim. Caudal segment about one sixth total length. Fins 5, the middle and anterior comparatively short. Seizing-hooks 8 or 9. Anterior teeth 7 or 8, the inner very much longer than the outer. Posterior teeth 10-12. Corona ciliata almost wholly confined to the head, of an irregular oval outline. Ovaries, containing well-advanced ova, short. No diverticula from digestive tract. Caudal segment not divided longitudinally by incomplete accessory septa, but showing an arrangement of the testes and developing spermatozoa like that figured by Grassi for *S. hexaptera* (Taf. ix. fig. 7). Muscles of body slenderly developed, causing the preserved specimens to have a very limp appearance. Epidermis but slightly thickened around the neck, if any at all.

Of the European forms, *S. flaccida* resembles *hexaptera* and *magna* the most closely. It differs from them, however, in being much smaller, in having a larger number of teeth, in the smaller size of the caudal segment, and in the shape of the corona.

6. *Sagitta tenuis*, sp. n.

S. tenuis is a small species from Jamaica very closely resembling *S. hispida*. I am indebted to Mr. C. P. Sigerfoos for the specimens, which were collected by him in Kingston harbour, June 1893. Maximum length 5.25 millim. Breadth 0.2 millim. Caudal segment about one fourth total length. Seizing-hooks 7-8. Anterior teeth 4-5. Posterior teeth 7-10. Shape of fins, of seizing-hooks, corona ciliata, accessory longitudinal septa in caudal segment, number of tactile

prominences, and muscularity of body as in *hispida*. No diverticula from digestive tract. In this form the nervous structures are especially large and prominent. The ovaries were short, though containing ova approaching maturity. Germinal epithelium composed of a single row of high columnar cells, not a double row of cubical, as in the forms like *bipunctata*.

S. tenuis differs from *hispida* in size, in the prominence of the nervous structures, in the relatively shorter caudal segment, and the absence of diverticula from the digestive tract. It might seem that the specimens were young *hispida*, were it not for the advanced ova and for the fact that diverticula were not present, while in *hispida* they are very apparent as early as twenty-four hours after hatching.

7. *Spadella draco*.

Among the *S. flaccida* collected by Dr. Andrews at Bimini was a single specimen of this species. The cosmopolitan nature of certain of the Chætognaths is well illustrated by it. In his article on "Les Chætognathes de la Baie d'Amboine" (Malay Archipelago), E. Béraneck says:—"La *Spadella draco* est la plus commune des espèces de ce genre trouvées dans la pêche pélagique de la baie d'Amboine."

8. *Spadella schizoptera*.

This very unusual species was described in the 'Circular' for June 1895. It is another of the forms from the Bahamas.

9. *Sagitta hispida*.

This form was described at the same time as the preceding. We have found it in Jamaica, at Beaufort, North Carolina, and at Bimini, in the Bahamas. Mr. A. Agassiz has found it elsewhere in the Bahamas, in the cruise of the 'Wild Duck' in 1893.

XXXIII.—*New Species of Pyralidæ &c. from the Khasia Hills.* By W. WARREN, M.A., F.E.S.

[Concluded from p. 177.]

ORTHOCONA, gen. nov.

Fore wings elongate; costa straight till shortly before apex; hind margin obliquely curved. Hind wings in female narrow,

in male broad and short, with shouldered costa; apex and hind margin rounded; inner margin largely developed. Antennæ lamellate (female); tongue and ocelli present; labial palpi large; second joint porrect, broad, curved beneath; third joint half as long as second, conical, erect in front of face, and articulated on to second, with a clear incision between them externally, as in *Agrotera*; maxillary palpi fine, porrect. Wings with hyaline discal mark in female.

Type *Orthocona eximialis*, Warr. (*Thysanodesma*).

Akin to *Agrotera*.

Since the description of *Thysanodesma eximialis* ♀ was written I have met with a pair in good condition, the female of which differs in certain particulars from the type formerly described; and as the male differs considerably from either, I append a fuller description.

Orthocona eximialis.

♀. Fore wings dark brown, with a strong violet lustre; the lines obscure; a large square white hyaline spot at end of cell, preceded and followed by a black spot; a smaller spot of the same character below it beneath the median; a yellow spot on costa above it, with a smaller yellow spot nearer base; first line visible only on the inner margin, the remainder lost in the dark basal patch; second line at three fourths, wavy to below middle, then incurved to touch the base of the discal spot, thence to inner margin in middle; the space included dark blackish brown, except a minute pale yellowish spot on median just beyond the discal spot; marginal area violet-brown; two yellow costal spots, one before, the other (larger) at apex; marginal line dark purple, preceded by a small yellow spot below apex and another above anal angle; fringe pale yellow, with a purplish apical and larger middle patch, these with a darker line along base. Hind wings with base dark; a central hyaline band containing the dark discal spot and a thick black line from the inner margin along its outer border; marginal area violet-brown, with a faint yellowish spot in the middle; fringe yellowish at apex and again before anal angle; the rest purple. Collar purple; face and thorax much varied with pale yellowish-white scales (abdomen wanting). Underside paler, more generally violet, with the yellowish places larger; both wings with a central pale yellowish hyaline fascia.

The male (of 24 millim. expanse), likewise from the Khasias, differs not only in size, as above indicated, but in markings, as follows:—The hyaline patches of the fore wings

and band of hind wings are wanting, being of the same violet-brown tint as the rest of the wings; but beyond the black discal mark of the fore wings is a bright white spot; the basal area is mixed with white scales; the yellowish costal spots are limited to a small one beyond the outer line and a similar small one at apex; the yellowish marginal spots of both wings are wanting; in the hind wings the outer line is as much excurved as in fore wings; on the underside the median area in both wings is paler, but does not form a distinct fascia.

Genus *METASIODES*, Meyr.

Metasiodes ? *apicalis*, sp. n.

Fore wings very long and narrow, pinkish fawn-colour, dusted thickly with very fine fuscous atoms; basal area suffused with cloudy fuscous; first line at one sixth, double, bent in middle, the lower arm vertical, closely followed by a subquadrate dark mark in the cell, and a smaller one below it; discal mark 8-shaped, with clear fuscous edges; second line at five sixths, fine, wavy, starting from a black costal spot; the median sinus outward approximates to the hind margin; a large oblong blackish blotch on hind margin below the apex, and a smaller squarish one above anal angle; a marginal row of blackish spots; fringes concolorous, with dark chequering. Hind wings like fore wings, without basal suffusion; an ocelloid discal spot and outer line as on fore wings, ending in a black blotch on inner margin; fringe as in fore wings. Head, thorax, and base of abdomen fawn-colour; face, collar, and rest of abdomen dark fuscous, the third segment black; base of anal segment black, with the anal tuft and end of preceding segment paler. Underside like upper.

Expanse of wings 24 millim.

Two males only from the Khasias.

The scaling of both wings is very fine and the wings themselves are semidiaphanous. I am by no means sure that this is a *Metasiodes*; the labial palpi are short, slightly upturned; the second joint hairy beneath, the third short, conical; maxillary palpi exceedingly minute; tongue well developed and ocelli distinct; antennæ of male simple, lamellate. The neuration is quite simple, the third and fourth subcostals only being stalked from end of cell.

Superficially the insect bears a great resemblance to Walker's *molusalis*.

Genus METASIA, Guen.

Metasia? fuscalis, sp. n.

Fore wings tawny brown, without any clear markings; in the middle of wing are three yellowish contiguous spots, one above the other, very obscure, and edged with darker; fringe concolorous. Hind wings rather paler, with whitish costa. Head, thorax, and abdomen concolorous. Underside fuscous, the inner margin of fore wings whitish.

Expanse of wings 24 millim.

One female from Bombay.

I have left this species in *Metasia*, but it will probably have to form the type of a distinct genus.

Metasia sabulosalis, sp. n.

Fore wings bone-colour, dusted with pale brownish; a pale brownish subcostal streak to beyond cell; first line curved at one fourth, second at five sixths, straight, but slightly wavy, to first median, shortly bent in along it, then oblique to inner margin at two thirds; a small discal ocellus, marginal area with a brown subapical cloud; fringe concolorous, with a darker basal line. Hind wings paler, without brown dusting except along hind margin; a brown submarginal line forming a shallow sinus in the middle. Head, thorax, and abdomen all bone-colour. Underside duller, with the outer line and discal rings indicated.

Expanse of wings 14 millim.

Several from Poona.

Genus DANAGA, Wlk.

Danaga costipunctata, sp. n.

Fore wings dark purplish brown, the lines hardly darker, but slightly edged with paler; first near base, indicated by a paler spot on subcostal and above the inner margin; second at five sixths, bent outwards below costa, thence vertical and slightly bent to the hind margin above anal angle, running in to below the discal spot, thence to inner margin beyond middle, edged faintly with paler; a small yellowish spot in cell, a larger subquadrate one at the end, edged outwardly by a black discal mark, which also has a paler margin; four yellow costal spots, two before and two beyond the middle; another at the apex; fringe pale yellowish below apex and at anal angle, fuscous at apex and between; the inner half

throughout chequered with a series of fuscous spots. Hind wings brown, with the outer line faintly expressed and indicated by a pale spot on hind margin, where the elbow touches it, and on inner margin, where it ends; fringe brown, with darker line near base, whitish before anal angle. Head, thorax, and abdomen concolorous, base of abdomen with a yellowish ring. Underside with basal half of wings pale yellow, marginal half fuscous; costa of fore wings yellow, with fuscous patches.

Expanse of wings 17 millim.

Two males from the Khasias.

Genus EURRHYPARODES, Moore.

Eurrhypoarodes confusalis, sp. n.

Fore wings yellow, with blotches and striæ, often confluent, of purple scales, overlaid with lustrous leaden scales; costa with seven or eight short thick strigæ, space between median and subcostal more or less filled with darker, including a square spot in the cell, followed by a discal ring; three other blotches are conspicuous, one below the costa obliquely above the discal mark, joined by two lines to another obliquely below it, and a third (the largest of all) on inner margin below the cell; hind marginal area with an agglomeration of small striæ; fringe yellow at apex and anal angle, purple between. Hind wings with a central curved line of blotches and the marginal area interruptedly filled with contiguous striæ; fringe yellow, varied with purple. Head, thorax, and abdomen yellow, much mixed with purple; the two basal segments of abdomen wholly yellow. Underside rather paler and duller.

Expanse of wings 19 millim.

One male from the Khasias.

The hind margin of hind wings is only slightly indented below the apex.

Genus BLEPHAROMASTIX, Warr.

Blepharomastix ? delicata, sp. n.

Fore wings narrow, elongate, pale bone-colour, with the marginal area and costa suffused with brownish flesh-colour; shortly before apex is a brown spot on costa, from which starts a slightly wavy dark line towards the anal angle, before which it becomes obsolete; a brown-black spot on hind margin below apex; fringe concolorous. Hind wings

and fringes white. Head, thorax, and abdomen ochreous; palpi dark brown above, white beneath. Underside whitish; the fore wings pinkish brown towards hind margin.

Expanse of wings 24 millim.

Two males from Onoribo.

The species is rather different from typical *Blepharomastix*, but I think it may be placed among them for the present.

LEUCOGEPHYRA, gen. nov.

Fore wings with costa nearly straight; apex produced; hind margin sinuous, bulged below the middle. Hind wings with apex bluntly produced, hind margin sinuous, forming a rounded bulge below middle. Labial palpi long, upcurved in front of face, the terminal joint short and aciculate; maxillary palpi filiform, horizontally porrect; tongue present; ocelli apparently absent; antennæ of male with close broad laminations, flattened and widened beyond the middle; hind tibiæ of male with four spurs.

Type *Leucogephyra semifascialis*, Warr.

Leucogephyra semifascialis, sp. n.

Fore wings pearly white, with a minute black dot at base of inner margin; a dark brown transverse line at one third, curved outwards in its upper half, then vertical and thicker; a small brown-black dot at lower end of discocellular; an exterior brown-black line formed of interrupted dashes between the veins from costa at four fifths, slightly curved outwards in upper half, then elbowed inwards and from below the cell-dot running obliquely inwards to inner margin; an oval red-brown blotch on middle of hind margin running obliquely through the fringes, which are white, with a very fine and delicate brown basal line. Hind wings pearly white, with a short basal line from inner margin; a broad black-brown fascia from inner margin above anal angle, mixed with white scales towards middle, and becoming ferruginous in middle of wing, where it ends abruptly, its edges being continued as divergent dark lines to the costa; fringe white, with fine basal line and two or three dark specks in the central bulge and at anal angle. Underside white, with the lines all marked, but the blotch of fore wings and fascia of hind wings greatly reduced. Head, face, thorax, and abdomen white, the latter with a broad black ring corresponding to the dark fascia of the hind wings; palpi with blackish scales externally; base of antennæ inside with a few black scales.

Expanse of wings 16 millim.

One male from the Khasias.

Subfamily *HYDROCAMPINÆ*.Genus *NYMPHULA*, Schrank.*Nymphula latifascialis*, sp. n.

Fore wings ochreous grey, with dull brown suffusion; the lines just paler, palest on the costa; first line at one third, sharply angled below costa, then oblique inwards, preceded by a dark brown shade; second line from costa at three fourths, sinuous and parallel to hind margin to first median, where it is sharply elbowed, then parallel to inner margin for a short space, and again parallel to hind margin to inner margin beyond middle; it is followed by a brown shade with irregular outward margin; space between the two lines on lower half of wing dark brown, connected with a dark brown central costal cloud; a concise marginal brown band, with dark dashes on the veins; fringe dark grey, with broad black basal line and whitish patches below apex and above anal angle. Hind wings grey, with a broad pale-margined central fascia, the edges of which are wavy, and a narrower one nearer the base; marginal band and fringes as in fore wings. Thorax brown; basal segment of abdomen pale, following segments brown; apical half ochreous; face paler; palpi dark brown. Underside glossy grey, with all the markings indistinct.

Expanse of wings 26 millim.

A male and female from the Khasias.

The female has a brown suffusion all over the fore wings, rendering the markings very obscure, and the whole insect darker than in the male.

Nymphula nigra, sp. n.

Fore wings blackish slate-colour, the markings paler but more or less indistinct; some obscure pale marks near base; outer line from beyond three fourths, a little indented below costa, then forming a semicircular curve to below the discocellular; centre of the wing occupied by a pale flattened 8-shaped mark, contiguous above to a smaller costal mark and below to a larger flattened oval one on inner margin; a pale curved shade before hind margin; fringe concolorous with a darker basal line. Hind wings dark grey. Head and thorax concolorous with fore wings; abdomen paler, more cinereous. Underside of fore wings uniform dark grey, of hind wings light grey.

Expanse of wings 20 millim.

Several of both sexes from the Khasias.

Genus OLIGOSTIGMA, Guen.

Oligostigma albidivisa, sp. n.

Closely allied to *O. hapilista*, Swinhoe, but with the markings less concise; in the fore wings the submarginal yellow band, instead of being of uniform width, with neat edges, and separated from the marginal band by a uniformly wide white space, is broader, diffusely edged externally with fuscous, and swelling out below the middle so as sometimes to touch the marginal band. In the hind wings, instead of the broad orange border with a single black line down the centre, there are two orange fasciæ separated by a narrow white space.

Expanse of wings 30 millim.

Several from the Khasias.

GETHOSYNE, gen. nov.

Fore wings with costa straight for two thirds, then strongly arched; apex blunt, rectangular; hind margin strongly bent at middle, the upper half vertical, the lower very oblique. Hind wings narrow, the hind margin as in fore wings, strongly bent opposite the cell. Labial palpi obliquely upcurved; the second joint thick, hairy beneath, the third short, with blunt apex; maxillary palpi filiform; tongue and ocelli present; antennæ lamellate, subdentate, and pubescent. Neuration: fore wings, cell half the length of wing; first median shortly before end of cell, second from the end, third and lower radial from the end of the discocellular; upper radial from below upper end of cell; last subcostal from the end, which is bent down; third and fourth stalked, with the second very closely approximated in male; in female the second anastomoses near its origin with the stalk of the other two, and runs halfway before separating. In the hind wings the first subcostal anastomoses with costal almost immediately; medians and radial as in fore wings.

Type *Gethosyne æquivocalis*, sp. n.

Gethosyne æquivocalis, sp. n.

♀. Fore wings ochreous white, with the basal three fourths almost wholly suffused with deep brown; the costa yellowish; an oblong white discal spot, edged with deeper brown, preceded in the cell by two small yellowish spots; another yellow spot in middle of base and two more near inner margin; exterior line at three fourths, thick, deep brown, forming two

irregular outward curves, then slightly incurved to inner margin, its lower course hardly discernible in the dark suffusion; this is followed by a twice curved fulvous line, which below the middle becomes darker and forms the outer edge of the dark suffusion; opposite the cell and below the elbow it is joined by a horizontal streak to the marginal line, which is very thick, deep brown, and running in along costa to the origin of the last line; the space beyond the last line is pure white; the rest of the paler portion of the wing is yellowish; fringe yellowish, chequered with brown. Hind wings like fore wings, the basal area only brownish, the two lines much more sinuous, the inner preceded by five or six oval yellow spots. Head, thorax, and abdomen deep brown, the last with the basal segments spotted with yellowish. Underside dull brownish, with the margins paler; cell-spot of fore wings large and pale, of the hind wings dark; the two outer lines both marked.

The male is much darker, being nearly wholly suffused with dark brown-black, leaving only the costa and spaces along the hind margin dull orange.

Expanse of wings, ♀ 24, ♂ 20 millim.

A few from the Khasias.

Genus *AMBIA*, Wlk.

Ambia complicata, sp. n.

Fore wings white, mostly suffused with blackish; costal region beyond the first line broadly yellow; antemedian line at one third, broadly angled in mid-wing, whitish, with a black edge; the basal area within it blackish, with traces of a pale subbasal line; postmedian line at two thirds, oblique outwards to opposite the cell, round which it forms a broad curve, which is slightly indented in middle, to beneath the discal spot, thence sinuous to inner margin beyond middle, white, edged with black; discal spot white, followed by a blacker patch in the dark suffusion; a dark spot on costa halfway between the two lines; in the yellow apical region is a small white subcostal blotch with black outward edging; a similar one on hind margin below apex and another above anal angle; fringe whitish, with a dark line near base. Hind wings with inner half white, the outer blackish; two curved white, thickly black-edged lines, one before, the other beyond the middle; traces of a pale submarginal line; hind margin yellow-tinged; fringe as in fore wings. Thorax and abdomen grey; face and palpi ochreous. Underside of fore

wings dark grey, with apex yellow; a pale narrow spot on costa at middle; outer line and cell-spot white. Hind wings whitish, tinged with yellow, and more fuscous towards costa.

Expanse of wings 12 millim.

One female from the Khasias.

Genus CYMORIZA, Guen.

Cymoriza albiflavidalis, sp. n.

Fore wings bright yellow; first line formed by two white spots below costa and a broad, oblique, silvery white streak to inner margin; this line is preceded by a smaller, less distinct, but similar basal line; outer line silvery white, interrupted below middle, its lower end marked by a broad horizontal blotch; the costal portion is preceded by two horizontal white streaks, the lower of which touches the white cell-spot; the yellow marginal band is preceded by a narrower silvery white one, which is curved round above the anal angle, so as to coalesce with the lower end of the outer white line; the white and yellow portions are all more or less distinctly edged with fuscous; the costal swelling also is fuscous. Hind wings with a narrow yellow band near base, a broad fuscous-edged central band swollen towards costa and containing a long black cell-spot, and the two outer bands as in fore wings. Head, thorax, and abdomen yellow, spotted with white. Underside like upper.

Expanse of wings 22 millim.

Two males from the Khasias.

Cymoriza fascialis, sp. n.

Fore wings olive-fuscous, dusted with dark grey scales; the lines white; first line double, curved and sinuous; outer line curved, parallel to hind margin, constricted below the centre, and preceded opposite the cell by a short whitish dash; submarginal line similar, but not reaching the inner margin; a marginal olive band, coalescing before the anal angle with the dark band between the two outer white lines; cell-spot black; the central area is the most darkened by dark grey scales. Hind wings like fore wings, the two white basal lines with their intervening olive central space occupying the base of the wing; central area still darker than in fore wings, with a black cell-spot on its inner edge. Abdomen olive-fuscous; head, thorax, and basal segments of abdomen fuscous, much mixed with whitish scales. Underside like

upper, but generally darker; the hind wings with a deep fuscous spot near base.

Expanse of wings 21 millim.

Several from the Khasias.

Cymoriza fulvalis, sp. n.

Fore wings orange-fulvous, dusted with fuscous in the spaces between the veins; first line silvery white, indicated by a spot on costa and inner margin and two or three smaller ones between, surrounded by fuscous scales; two whitish spots surrounded with fuscous in the basal area; cell-spot white, edged with black, with a horizontal white mark above it, nearer the base in the male than in the female; outer line consisting of a broad white vertical blotch from costa, the inner edge of which is incurved in middle, and a white horizontal blotch above the submedian vein before the anal angle, with a small white dash obliquely above it (in the male there are two); the white costal blotch is preceded by a horizontal streak opposite the cell, and in the male by another below the costa; a broad orange marginal band from apex to the end of the white blotch before anal angle, separated from another submarginal similar band with fuscous edges by a row of white spots between the veins, the spots in the middle more or less obliterated by dark fuscous scales; on the outside of the outer band is a row of small blackish triangles; fringes with black basal line. Hind wings the same, with the discal spot larger. Thorax and abdomen fulvous, mixed with fuscous, the abdomen with white dorsal spots; head whitish ochreous; face silvery white; palpi with second joint dark fuscous, terminal joint white. Underside like upper, but somewhat duller.

Expanse of wings, ♂ 26, ♀ 30 millim.

A few from the Khasias.

Cymoriza interruptalis, sp. n.

Fore wings brown-black; lines silvery white, first at one third, indicated by a spot on costa and inner margin and one or two between them; cell-spot white, minute, edged with black; outer line represented by a white vertical line from costa shortly before apex, and a horizontal line on the submedian fold before the anal angle, with a dull orange smear beneath it; a broad orange marginal band, much suffused and chequered with dark scales, edged inwardly by a thick black line, which is preceded by a row of triangular white spots; fringes short, with a black basal line. Hind wings

the same, but the extreme base orange; the white submarginal line interrupted in the middle of wing. Head, thorax, and abdomen brown-black. Underside like upper, but duller.

Expanse of wings 26 millim.

A pair from the Khasias.

Genus SUFETULA, Wlk.

Sufetula nana, sp. n.

Fore wings pale grey, towards the base dusted with blackish scales; first line at one third, blackish, angled outwards below the middle; basal area with four or five minute pale dots with dark edges; second line close to and parallel to hind margin, blackish, preceded above the inner margin by another short line; marginal space slightly darker, with a black dash across it below the sinus; costa before apex with three or four pale dark-centred semiannuli; a rather large dark cell-spot; marginal line blackish; fringe grey. Hind wings whitish, with faint traces of a submarginal line and with a blackish blotch above the anal angle. Head, thorax, and abdomen grey; hinder half of abdomen blackish (? natural). Underside pale, with the markings faint.

Expanse of wings 11 millim.

One male from Bombay.

Subfamily GALLERIINÆ.

EMBRYOGLOSSA, gen. nov.

♀. Fore wings elongate; costa arched at base and faintly curved towards apex, which is blunt; hind margin evenly curved; inner margin convex and scaled. Hind wings longer than broad, the inner margin short, hind margin slightly curved. Abdomen thick, reaching beyond hind wings; the anal segment squared; antennæ (♀) subserrate, ciliated, the basal joint thickened, with a tuft of hair on the inner side projecting in front of face; tongue aborted, consisting only of two short curled scaly processes; maxillary palpi absent; ocelli present; labial palpi long, porrect, pointed, the second joint with short scales, the third naked. Neuration: fore wings, cell half as long as wing; first median at four fifths, second a little before lower angle of cell, third from the angle, lower radial just above, upper radial from upper angle; first two subcostals free, last three stalked, the third and fourth shortly stalked from the fifth. Hind wings with costal free, the subcostals short-stalked;

lower arm of discocellular very oblique; first median at one half; the others as in fore wings.

The male is considerably smaller than the female. The abdomen has the anal tuft strongly developed and a tuft of hairs at base of costa beneath; antennæ ciliated, with the basal joint very long, slightly curved outwards, with a tuft on the inner side towards its apex, the shaft articulated at an angle. In both wings the third median and the radial are on a short stalk and in the hind wings the first median is at four fifths, as in fore wings.

Type *Embryoglossa variegata*, sp. n.

Embryoglossa variegata, sp. n.

♀. Fore wings dull green, much suffused with blackish, and with red scales intermixed; basal area blackish, ill-defined, bounded by a paler line, which is only distinct towards inner margin; a large black cell-spot; outer line from three-fourths of costa, running out towards hind margin, strongly denticulated in middle, incurved below middle, and edged in its lower portion with whitish scales; a blackish suffusion from apex to first median extends below costa nearly to discal spot, and between the median and submedian is continued, mixed with reddish scales, to join the projection of the basal patch; costa before apex with black dashes, separated by paler; a larger reddish-white spot before apex; anal angle with a tawny and red elongated blotch; veins beyond the middle blackish; marginal line distinct, black, with white dots at the ends of the veins; fringe dark at apex, reddish with black mottlings in middle, and altogether reddish at anal angle. Hind wings shining, fuscous grey, with traces of a pale curved and denticulated postmedian line, with a more distinct whitish denticulation on the first median; fringe reddish ochreous, marginal line indistinct, but the whitish dots at end of veins plain. Head, face, and front of thorax rufous; thorax and abdomen with mixed green, fuscous, and ochreous scales; the base of patagia dark fuscous. Under-side dark glossy grey, with a pale curved outer line on both wings; apex of fore wings pale ochreous, with red scales intermixed.

Expanse of wings 50 millim.

In the male, which is much smaller, the basal and marginal areas of fore wings are paler and the central area darker; the discal spot is large and pale, with a narrow dark centre.

Expanse of wings 34 millim.

A few from the Khasias.

Family Thyrididæ.

Genus STRIGLINA, Guen.

Striglina duplicifimbria, sp. n.

Fore wings reddish ochreous, with blackish reticulations and spots; the costa fuscous tinged, darker towards base; an elongated rounded black spot at end of cell and a square black spot below it above inner margin; four round black spots towards hind margin, the lower pair nearer the margin than the upper; the whole wing with interrupted, and sometimes interlacing, black strigulæ in more or less vertical rows; fringe brown-red, very broad, with a black line down the middle and traces of dark scales beyond it. Hind wings rather paler; a black streak near base; a blackish spot at end of cell and another below it near inner margin; five or six round black spots towards apex, the innermost the largest, and one spot towards anal angle; fringe as in fore wings. Head, thorax, and abdomen reddish ochreous. Underside paler, with all the spots more distinct.

Expanse of wings 32 millim.

Several of both sexes from the Khasias.

Distinguished not only by the very broad fringe, but by the subfalcate fore wings and bowed hind margin.

Genus BANISIA, Wlk.

Banisia dissimulans, sp. n.

Fore wings dull grey-brown or fawn-colour, with darker markings; three darker vertical fasciæ, two antemedian, the third postmedian and curved outward in the upper half of wing; a fourth curved fascia not darker than the ground-colour, with the edges parallel to the hind margin of the third fascia, and starting from oblique *y*'s on the costa, the pale spaces between the fasciæ with a dark crinkly line down the middle, the whole surface thickly covered with transverse striæ and reticulations. Hind wings with the fasciæ only outlined, covered with a network of interlacing contorted striæ; fringes of both wings darker. Thorax dark fawn; head and abdomen paler. Underside redder and brighter.

Expanse of wings 40-50 millim.

A large number from the Khasias.

There is a specimen in the British Museum collection from Sylhet. Duller and greyer than *Pharambara reticulata*, Moore; in the character of the markings more resembling *B. tetragonata*, Wlk.

Banisia ordinaria, sp. n.

Fore wings dull brownish drab, with darker shading and reticulations; a basal patch, a narrow antemedian fascia, nearly vertical, and a postmedian fascia, forked below the middle and becoming obsolete towards inner margin, its outer edge angulated in mid-wing, all slightly darker; the whole wing covered with dark, more or less interlacing strigulae; fringe concolorous, darker towards the apices, and faintly chequered with darker. Hind wings with a dark line near base and a dark irregular central fascia, the whole wing reticulated; fringe as in fore wings. Head, thorax, and abdomen concolorous; collar and front of thorax darker. Underside brighter, more fulvous, with the fasciae dull orange.

Expanse of wings 34 millim.

One female from Mackay, Queensland.

There are three examples unnamed in the British Museum collection from Borneo which appear to be identical with the present insect. It is most nearly allied to *Banisia tetragonata*, Wlk., and *B. dissimulans*, Warr.

BEGUMA, gen. nov.

Fore wings with costa nearly straight, convex before apex; apex rounded; hind margin well curved. Hind wings with hind margin rounded; inner margin short; anal angle rounded off. Antennae (♀) thick, closely lamellate; palpi porrect, the second joint slightly hairy beneath and curved, the third minute, pointed; tongue feeble. Neuration: fore wings, cell half as long as wing; discocellular apparently interrupted. First median from two thirds, second just before lower angle, third from the end; lower radial from a little above the angle, upper radial from above the middle of discocellular; last subcostal from below the upper angle, third and fourth stalked from the angle, second just before the end, first from one half; from the base of the last subcostal a veinlet runs basewards to the subcostal at about three fourths. Hind wings: costal free; first subcostal from well before the end of cell, second from the end; medians and radial as in fore wing; the discocellular is strong, complete, and angulated; scaling dense.

Type *Beguma constellata*, sp. n.

Beguma constellata, sp. n.

Fore wings dull rosy, deepening towards the base, and there black-brown, fading towards the hind margin to pearly grey,

the veins, however, remaining rosy; the costa pearly grey from near base; fringes grey. Hind wings the same, bright rosy from base of inner margin. Head, face, and palpi rosy brown; thorax black-brown; abdomen dull rosy grey. Underside rosy, with a fulvous tinge, the fore wings black-brown at base; rows of spots of raised silvery lilac scales radiating outwards from the base along the intervals between the veins, becoming fainter beyond the middle.

Expanse of wings 50 millim.

One female from the Khasias.

The only example is somewhat worn; it is probable that when fresh the rosy tint above extends to the hind margin and the silver spots below are more abundant.

Genus PHARAMBARA, Wlk.

Pharambara curvilinea, sp. n.

Fore wings pearly grey, suffused with pale coppery, and below the middle with a bronzy-grey tinge; the reticulations and lines dark brownish; a narrow angulated subbasal fascia, a nearly vertical antemedian, and a broader outwardly curved postmedian fascia coppery; the intervening spaces on the costa pale grey; beyond the postmedian fascia is a whitish-grey blotch on the costa, followed by a dark brown almost semicircular line from costa to below middle, thence obliquely to inner margin before anal angle; the whole wing covered with rather obscure dark grey, and, towards hind margin, dark brown reticulations and streaks; fringe coppery, with a broad dark central line. Hind wings with three dark brown lines parallel to one another and at equal distances, the median followed by a greyish shade, the postmedian by darker reticulations. Head, thorax, and abdomen concolorous. Underside brighter; fore wings with a bright chestnut subcostal streak, broader at apex; some black and white longitudinal scales beneath it; the lines and reticulations of both wings distinct, dark brown.

Expanse of wings 26 millim.

One male from the Khasias.

Pharambara fallax, sp. n.

Fore wings mouse-colour, suffused and strigulated with darker; some irregular dark greyish-black spots along the hind marginal area; fringe darker; in certain lights a broad basal and a narrower median and postmedian fascia can be seen, slightly darker than the rest of the wing. Hind wings paler. Head, thorax, and abdomen dark mouse-colour;

basal segments of the latter a little paler. Underside pale ochreous; the costa of fore wings neatly marked with vertical black strigæ; a velvety black discal blotch, with orange markings in the middle and long yellowish streaks and scales above and below them; a bright chestnut stripe below costa from middle to apex; a vertical chestnut fascia from inner margin beyond middle to a dull blackish subcostal spot; a broader chestnut fascia from before anal angle to near costa, thence bent obliquely to middle of hind margin. Hind wings with indications of chestnut fasciæ towards apex and hind margin.

In the female the velvety black discal blotch is much reduced and the subcostal stripe is continued to the base.

Expanse of wings 24 millim.

Several from Biak and Humboldt Bay, New Guinea.

Family Epiplemidæ.

Genus DIRADES, Moore.

Dirades? ambigua, sp. n.

Fore wings greyish fawn-colour, slightly dusted with dark atoms; the lines ferruginous, first from costa at one third to middle of inner margin, strongly curved outwards in the middle, second at two thirds, also curved outwards to the middle, then inbent, and reaching the inner margin at three fourths; the space included between the lines slightly darker than the rest of the wing; a ferruginous triangular blotch on hind margin opposite the cell, with three black spots along its inner edge, often confluent, and a minute isolated black dot above it; fringe chequered pale ochreous and dark grey, with a rather broad dark grey basal line. Hind wings like fore wings, with two isolated black submarginal dots, one near the base of each tail. Head, thorax, and abdomen concolorous with wings; face dark brown. Underside pale grey, with darker frecklings; the hind wings paler than the fore wings, with the second black dot expressed.

Expanse of wings, ♂ 20, ♀ 24 millim.

Several from the Khasia Hills.

The male is paler throughout than the female, and the first line appears to start from the costa further from the base. There is no trace in the hind wings of the male of any tuft of hair or distortion of the veins on the inner margin; in the fore wings the apex is bluntly rounded; the hind margin oblique and faintly excised opposite the cell; in both sexes

the hind wings are tailed at veins 4 and 7, and the costa excised in middle, with a fringe of hairs on each side of the excision.

Genus EPIPLEMA, H.-S.

Epiplema castanea, sp. n.

Fore wings fawn-grey, freckled with blackish; the median area filled up with chestnut-brown; first line from costa at one fourth to inner margin at one third, black-brown and distinct, bluntly angled on the subcostal and median nervures; second from costa beyond middle to inner margin at three fourths, angled outwards on the subcostal, inwards on the radial, with a blunt prominence on veins 3 and 4 and another on the submedian above the inner margin; marginal third clouded in places with darker, especially above anal angle; a brown-black curved marginal line along the subapical excision. Hind wings the same, but the chestnut shade of the median area extends also over the marginal area except at the anal angle and along the inner margin, which remain, like the basal area, clear grey; fringes concolorous. Head, thorax, and abdomen grey; face and palpi darker. Under-side grey, freckled with black; the fore wings darker than the hind ones; the single female is paler throughout than the male.

Expanse of wings 26 millim.

Both sexes from the Khasias.

The fore wings have the hind margin deeply excised from vein 7 to 3, slightly excised again between 3 and 2 and 2 and the anal angle; the hind wings have the hind margin tailed at vein 7, with a small tooth at veins 6 and 4. The neurotation of the hind wings is abnormal; the discocellular and radial are absent; the inner marginal area is restricted, the inner margin itself being in the male folded over; there is a bed of dark scales towards the base beneath the median nervure and a long tuft of pale ochreous hairs from the base of the wing; veins 2, 3, and 4 are visible in the female, but vein 2 is either absent or hidden by the fold in the male. In both sexes the costa of hind wings is excised in middle, with a strong tuft of hairs along it on either side of the excision.

Epiplema flavigutta, sp. n.

Fore wings very much as in *E. moza*, Butler, but the three dark submarginal specks are more or less confluent and form a dark brown crescent. In the hind wings, instead of the

grey lunules with white lines there are two yellow confluent blotches between the tails (the lower one edged below with black), and before the lower tail a small black dot. The hind margin of the fore wings is excised from the apex to vein 4, and the hind wings are tailed at veins 7 and 4.

Expanse of wings 26 millim.

Both sexes from the Khasias.

Like *E. moza* this species occurs of two sizes, the larger form reaching 32 or 34 millim.

XXXIV.—*Descriptions of Four new Lizards from Roebuck Bay, N.W. Australia, obtained by Dr. Dahl for the Christiania Museum.* By G. A. BOULENGER, F.R.S.

Diplodactylus stenodactylus.

Head very convex; snout rounded, as long as the distance between the eye and the ear-opening, slightly longer than the diameter of the orbit; ear-opening small, round. Body and limbs rather stout. Digits cylindrical, not dilated at the ends, covered above and below with small granular scales; apical shields small, longer than broad. Body and limbs uniformly granulate above and below. Granules on the snout a little larger than those on the back of the head; rostral twice as broad as deep, with median cleft above; nostril pierced between the first labial, a large internasal, which is in contact with its fellow, and four granules; ten upper and as many lower labials; symphysial trapezoid; no chin-shields, but enlarged flat granules gradually passing into the minute granules of the throat. Male with three præanal pores on each side and a conical tubercle on each side of the base of the tail. Pale brownish above, with a light, brown-edged vertebral stripe bifurcating on the neck, passing through the eyes, its branches meeting again on the end of the snout; the brown dotted with lighter; lower parts white.

	millim.
From snout to vent.....	45
Head.....	12
Width of head.....	8
Fore limb.....	14
Hind limb.....	19

This new species, described from a single male specimen without tail, is allied to and appears to connect *Diplodactylus*

Steindachneri, Blgr., and *Ceramodactylus damæus*, Lucas and Frost, the latter probably bearing no real affinity to the genus to which it has been referred.

Egernia Dahlii.

Head short. A strong curved groove behind the nostril; nasal divided below the nostril; frontonasal broader than long, forming a broad suture with the rostral; præfrontals forming a median suture; frontal about once and a half as long as broad, a little longer than the interparietal; five supraoculars, second largest; eight or nine supraciliaries; sixth and seventh upper labials below the eye; three large temporals and a pair of large nuchals. Ear-opening as large as the eye-opening, with five or six short obtuse lobules anteriorly. 46 scales round the middle of the body, smooth, or dorsals faintly striated, laterals smallest, ventrals a little smaller than dorsals. The adpressed limbs just meet. Digits short. Tail compressed, tapering to a fine point, a little longer than head and body. Uniform pale reddish brown above, grey on the sides, white beneath.

	millim.
Total length	440
Head	38
Width of head	32
Body	172
Fore limb	52
Hind limb	66
Tail	230

Two specimens.

In its large size and stout form this species resembles *E. dorsalis*, Ptrs., and *E. major*, Gray, from both of which it is easily distinguished by its smaller scales and smaller ear-lobules. The large size and shorter head distinguish it from *E. Whitii*, Lacép.

Lygosoma ocellatum.

Section *Hinulia*. The distance between the end of the snout and the fore limb is contained once and a half in the distance between axilla and groin. Snout moderate, obtuse; loreal region nearly vertical. Lower eyelid scaly. Nostril pierced in a semidivided nasal; no supranasal; no postnasal; rostral widely separated from the frontonasal, which is broader than long; præfrontals in contact with their inner angles; frontal a little longer than the frontoparietals and interparietal together, in contact with the three anterior supraoculars; four

supraoculars, second largest; seven supraciliaries, first largest; frontoparietals distinct, as long as the interparietal; parietals forming a suture behind the interparietal; two pairs of nuchals; sixth and seventh upper labials below the eye. Ear-opening oval, as large as the eye-opening, the anterior border with four or five pointed lobules. 36 smooth scales round the body, laterals smallest, dorsals as large as ventrals. Two enlarged præanals. The hind limb reaches the wrist of the adpressed fore limb. Toes rather long and slender, compressed; subdigital lamellæ unicarinate, 22 under the fourth toe. Brown above and on the sides, with ten longitudinal series of elongate white, black-edged ocellar spots; posterior upper labials vertically barred black and white; auricular lobules white; lower parts uniform white.

	millim.
From snout to vent	95
Head	16
Width of head	11
Fore limb	24
Hind limb	40

A single specimen.

Lygosoma Colletti.

Section *Hinulia*. The distance between the end of the snout and the fore limb is contained once and two thirds in the distance between axilla and groin. Snout moderate, pointed; loreal region nearly vertical. Lower eyelid scaly. Nostril pierced in the centre of an undivided nasal; no supranasal; no postnasal; rostral widely separated from the frontonasal, which is broader than long and narrowly in contact with the frontal; latter shield as long as its distance from the posterior border of the parietals, in contact with the three anterior supraoculars; four supraoculars, first largest; seven supraciliaries, first largest; frontoparietals distinct, as long as the interparietal; parietals forming a suture behind the interparietal; three pairs of nuchals; fifth and sixth upper labials below the eye. Ear-opening smaller than the eye-opening, with a large opercle-like scale on its anterior border. 24 smooth scales round the body, the two median dorsal and ventral series largest. Two large præanals. The hind limb reaches the elbow of the adpressed fore limb. Toes long and slender, compressed; subdigital lamellæ unicarinate, 23 under the fourth toe. Pale brownish above, with seven dark brown longitudinal streaks; a black stripe on each side, from the end of the snout to near the end of the tail; below this a

white lateral stripe edged with grey; head golden above, with five dark brown longitudinal lines; upper lip and lower parts uniform white.

	millim.
Total length	131
Head	9
Width of head	5
Body	32
Fore limb	12
Hind limb	18
Tail	90

A single specimen.

XXXV.—*Descriptions of some new Species of Heterocera from Hunan, Central China.* By HERBERT DRUCE, F.L.S. &c.

Fam. Chalcosiidæ.

Corma laranda, sp. n.

Male.—Primaries and secondaries smoky black: primaries, a small greyish-white spot at the base of the cell, and one below near the inner margin; a greyish-white curved band crosses the wing at the end of the cell, extending from the costal margin to near the anal angle, beyond which are two apical greyish-white spots. Underside greyish white, with the black spots very distinct, but very much larger than they are in *Corma maculata*, Hamps. The head, thorax, and abdomen black, the collar and tegulæ edged with yellow; the underside of the thorax and abdomen yellow; the legs yellow; antennæ black.—*Female* very similar to the female of *C. maculata*, but with all the black markings rather larger.

Expanse, ♂ $2\frac{2}{10}$, ♀ $2\frac{1}{2}$ inches.

Hab. China, Hunan (*Mus. Druce*).

Pintia litana, sp. n.

Male.—Primaries and secondaries brownish black; primaries streaked with white at the base and crossed about the middle by a band of six elongated greyish-white spots, the first two in the cell, beyond which is a subapical band of

five small greyish-white spots: secondaries, the costal margin, a streak in the cell, and three spots below the cell all greyish white, the inner margin of the wing irrorated with greyish-white scales; the fringes of both wings black. Underside very similar to the upperside, but with the white markings more distinct and with the base of the primaries steel-blue. The head, antennæ, and tegulæ bluish black, slightly metallic; the collar bright orange; thorax and abdomen black, the underside of the abdomen greyish white; the legs black on the upperside, white on the underside.—*Female* very similar to the male, but the markings larger and purer white.

Expanse, ♂ $2\frac{6}{10}$, ♀ 3 inches.

Hab. China, Hunan (*Mus. Druce*).

Fam. *Limacodidæ*.

Phocoderma betis, sp. n.

Primaries reddish fawn-colour, the basal half of the wing the darkest; a pale brown line crosses the wing from the costal margin near the apex to the inner margin near the base; a narrow dark brown submarginal line extends from the apex to the anal angle; the fringe brownish fawn-colour: secondaries uniformly pale fawn-colour. Head, thorax, and abdomen fawn-colour; palpi dark brown; legs brown.

Expanse $2\frac{1}{2}$ inches.

Hab. China, Hunan (*Mus. Druce*).

This species is allied to *P. velutina*, Kollar.

Cania hatita, sp. n.

Primaries pale yellowish brown, darkest along the costal margin; two narrow brown lines cross the wing about the middle, extending from the costal to the inner margin: secondaries pale yellowish brown; the fringes of both wings the same colour. Head, thorax, abdomen, and legs pale brown.

Expanse $1\frac{1}{2}$ inch.

Hab. China, Hunan (*Mus. Druce*).

XXXVI.—*Necrophagous Diptera attracted by the Odour of Flowers*. By E. E. AUSTEN, Zoological Department, British Museum.

THE British Museum has recently received from Mr. J. H. Hart, F.L.S., Superintendent of the Botanical Department, Trinidad, W.I., a series of *Diptera*, accompanied by the following note:—" . . . you mentioned you would at any time be glad of *Diptera*. Herewith I send you a miscellaneous collection caught in a flower of *Aristolochia gigas*, var. *Sturtevantii*. This flower gives off an odour indistinguishable from that of carrion, so much so that it has on several occasions attracted the vultures of our island (*Cathartes aura*) and set our workmen hunting for dead fowls &c. The plant is an introduction, but we have a smaller and similar one, a native. I think it may be taken, therefore, that the flies will represent the carrion-flies of our district."

Unfortunately, owing to the fact that they were not sent pinned, but simply wrapped in an envelope of stout paper, which was inserted in a cardboard case for transmission, the specimens arrived in fragments; consequently the task of determination, never an easy one in the case of flies belonging to the present group, has been rendered vastly more difficult. However, so far as I have been able to make them out, the *Diptera* forwarded by Mr. Hart belong to the following species, which, it will be observed, are all of them true *Muscidæ* (including *Anthomyinæ*):—

- | | |
|---|--------------------------------------|
| 1. <i>Lucilia</i> , sp. | } Some half-dozen specimens of each. |
| 2. <i>Lucilia</i> , sp. alia. | |
| 3. <i>Comptosia macellaria</i> , F. | Twelve specimens. |
| 4. <i>Tachininæ</i> , gen. et sp. incert. | A single specimen. |
| 5. <i>Musca domestica</i> , L. | A single female. |
| 6. <i>Sarcophaga</i> , sp. | Two males, two females. |
| 7. <i>Ophyra ænescens</i> , Wied. | One male, six females. |

In the case of each of the species of *Lucilia* above referred to the wings are yellowish, with the apical third brown, while the antennæ, face, and cheeks are orange-yellow; in one of the species, however (the larger, ranging apparently from 9 to 11 millim. in length), the frontal stripe and pleuræ are also orange-yellow, while in the other and smaller species the frontal stripe, except a spot immediately above the base of the antennæ, is black, and the pleuræ are metallic green. In each species the greater portion of the first abdominal segment

is yellow or orange. The larger of the two species appears to be closely allied to, if not actually conspecific with, a specimen from Mexico (*ex Coll. Saunders*), placed in the Museum collection under *Musca*, and labelled "*femorata*, W.," in Walker's handwriting—therefore presumably a type. I have, however, failed to discover where this species was described. Moreover, the Museum collection already contains undetermined specimens of both of the Trinidad species of *Lucilia* from the Amazon, collected by Bates. I did not myself meet with either during a recent expedition to the Lower Amazon, but no doubt the species are widely distributed in the Neotropical Region.

Compsomyia macellaria, F., the most numerously represented species in the above list, is also the most interesting, since its larvæ, known as "screw-worms" in the south and west of the United States, besides attacking various domestic animals, have frequently caused death in the human subject by their ravages in the nasal fossæ and frontal sinuses*. For this reason the species was described by Coquerel† as *Lucilia hominivorax*, from specimens bred from larvæ the attacks of which had proved fatal to a French convict in Cayenne. According to one of Dr. Coquerel's informants similar cases are pretty common among the French convicts in Guiana, and an instance of non-fatal attack has been reported from Trinidad itself‡. P. S. de Magalhaes, in recording the fly as having been bred from larvæ from the nasal fossæ of the human subject at Rio de Janeiro, points out § the wide distribution of the species, which ranges from the Argentine and Chili to the southern United States of North America. I myself met with it on the Amazon and the Pará River.

The solitary Tachininid sent is a mere fragment, which it

* Cf. Ann. & Mag. Nat. Hist. ser. 5, vol. xii. (1883) pp. 353–355.

† Ann. Soc. Ent. Fr. sér. 3, t. vi. (1858), pp. 171–176. See also Coquerel, Ann. Soc. Ent. Fr. sér. 3, t. vii. pp. 233–237: "Nouveau cas de Mort produit par la *Lucilia hominivorax*, et description de la larve de ce Diptère."

‡ Vide 'Trinidad Field Naturalists' Club,' vol. i. no. 3, Aug. 1892, pp. 59–61. See also a paper entitled "The Cattle Fly, *Compsomyia macellaria*," by C. W. Meaden (*ibid.* vol. ii. no. 11, Dec. 1895, pp. 279–281), dealing with the presence of the larvæ in sore places on cattle. The author states that he has never observed the fly on dead animals: this is curious, as at Mosqueiro, on the Pará River, I took it on a dead kid. From "Observations on the Insects of Jamaica," by William Jones (Journ. Institute of Jamaica, vol. i. no. 8, Dec. 1893, p. 372), it would appear that attacks by this fly on human beings are common enough in Jamaica, or, at any rate, were so in the earlier part of this century.

§ Bull. Soc. Zool. France, t. xx., 1895, p. 117.

is quite impossible to determine. Its occurrence at all in such company is difficult to understand, unless it had visited the flower as it would visit any other, since the Tachininae are met with on flowers and leaves, and are not necrophagous; their larvæ are well known as internal parasites of caterpillars and other insects.

I am not aware that *Musca domestica*, L., has hitherto been recorded from Trinidad, though the species is known to occur in Brazil and in Porto Rico and Guadeloupe in the Antilles. I have nowhere seen it in such swarms as in a house about two miles from Pará. It is probable that this species is now cosmopolitan, having been carried by ships all over the civilized world.

The specimens of *Sarcophaga* are in so hopeless a condition that it would be futile to attempt to determine the species, which, however, belongs to the group without dorso-central bristles. The median of the three stripes on the thorax has a distinct narrow dark line on each side of it, the face and orbits are golden, the hypopygium of the male and the anus of the female orange-red, and the middle and hind tibiae of the male are clothed on the inside with long hair.

Ophyra ænescens was described by Wiedemann (Auss. zweifl. Insekten, ii. p. 435. 29) from New Orleans and has been recorded by Macquart (Dipt. Exot. 1^{er} Suppl. p. 203. 4) from Galveston, Texas. I may add that Schiner ('Fauna Austriaca,' Diptera, i. p. 620) mentions that he once found the European *Ophyra anthrax*, Mg., in countless numbers round a dead horse.

So far as I have been able to discover, no instance of necrophagous Diptera being attracted by malodorous flowers has as yet been recorded from the New World. The late Mr. C. V. Riley found the larva of a *Sarcophaga* feeding on the putrid insect-remains in the pitchers of two species of insectivorous plants—the spotted trumpet-leaf (*Sarracenia variolaris*, Michx.) and the yellow trumpet-leaf (*S. flava*, L.). Riley described the fly as *Sarcophaga sarraceniæ*, but afterwards thought that it might be only a variety of the common European *S. carnaria*, L.* Here, however, the dead insects and not the flower itself had formed the attraction. But in the Old World several cases similar to the present have been described. M. Schnetzler, writing "On the part played by

* Riley, Trans. St. Louis Acad. of Nat. Sci. iii. p. 239; 'Science Gossip,' 1874, pp. 274-275, fig. 182; Canad. Ent. vi. pp. 209-214, fig. 26; Seventh Ann. Rep. Ins. State of Missouri, 1875, p. 181.

Insects during the Flowering of *Arum crinitum*, Ait."*, states that the spathe of this flower "diffuses so strong an odour of putrid flesh that the insects which deposit their eggs upon decomposing animal matters are attracted by it." *Lucilia casar*, L., visits the flower in numbers and oviposits among the viscous hairs lining the interior of the spathe. All the flies found by M. Schnetzler at the bottom of the spathe were dead, and the author gives reasons for considering that the insects may furnish nitrogenous nutriment to the plant through the medium of fluid contained in certain hairs which clothe a great part of the inner surface of the spathe. Other flies, however, less pressed to oviposit may not penetrate further than the stamens, and may thence convey the pollen to the stigmas or fly away to lay their eggs in the spathe of another plant, on the stigmas of which they deposit the pollen which they have carried away from the stamens of the former one. Doubtless the Trinidad flies perform a similar office for *Aristolochia*.

Dr. Ch. Coquerel, in discussing the reason why *Comptosomyia macellaria*, Fabr., sometimes attacks man, mentions that the blow-fly (*Calliphora vomitoria*, L.) † oviposits on *Arum dracunculoides*, L. (= *Dracunculus vulgaris*, Schott), being deceived by the corpse-like odour of the plant ‡.

Mr. H. O. Forbes, in recording the discovery of "a fine new species of that curious family the Rafflesiaceæ," which he found growing on the side of the volcano called Dempo, in Sumatra, writes:—"It smelt powerfully of putrid flesh, and was infested with a crowd of flies, which followed me all the way as I carried it home" §.

Lastly, I am informed by Lieut.-Col. C. T. Bingham that *Amorphophallus campanulatus*, Roxb., an arum which has been introduced into S. Tenasserim by the Malays and is now very common in that district, gives off a most overpowering and fetid odour of carrion from its livid purple spadix, and is most attractive to flies.

* Ann. & Mag. Nat. Hist. ser. 5, vol. iv. pp. 399-400 ('Comptes Rendus,' Sept. 8, 1879, p. 508).

† ? *C. erythrocephala*, Mg.

‡ Coquerel, Ann. Soc. Ent. Fr. sér. 3, t. vi. (1858) p. 176.

§ Henry O. Forbes, 'A Naturalist's Wanderings in the Eastern Archipelago' (1885), p. 206.

XXXVII.—*Description of a new Species of Satyrid Butterfly from Costa Rica.* By H. GROSE SMITH, B.A., F.E.S., F.Z.S., &c.

Oxeoschistus cothonides.

Male.—*Upperside.* Anterior wings resemble *O. cothon*, Salvin. Posterior wings, discal area bright tawny, with a broad marginal border of dark brown, irregularly indented by the tawny area between the veins; a dark brown spot centred by a white dot situate in the tawny area between the two lowest median nervules, and two similar contiguous spots above the anal angle, as in *O. cothon*. The discal area becomes darker tawny brown towards the base and inner margin, the darker area extending transversely from the middle of the costa and crossing the cell a little beyond its middle towards the anal angle, where it merges in the dark brown marginal border. The female resembles the male.

The *underside* does not differ appreciably from *O. cothon*.

Hab. Cartago, Costa Rica.

Expanse of wings $2\frac{1}{2}$ inches.

Described from one male and two female specimens. At first I thought this insect might be the female of *O. cothon*; but there being both sexes in the collection, and possessing a female of *O. cothon* which does not differ from the male, I conclude that the very distinct colouring of the upperside of the posterior wings justifies me in describing it as distinct from *O. cothon*. The specimens were sent by Mr. Underwood with a good series of *O. cothon* from the same locality.

XXXVIII.—*On Mammals from Celebes, Borneo, and the Philippines recently received at the British Museum.* By OLDFIELD THOMAS.

THE specimens referred to in the present paper were mostly collected by Messrs. Charles and Ernest Hose in N. Celebes and by Mr. Alfred Everett at the extreme south of the same island, and both at about the same date, October to December 1895. One of the chief objects of these naturalists was to obtain for our National Museum specimens of the numerous small mammals that have been described of late years from the island of Celebes and have hitherto been unrepresented in the British Museum. This object has

happily been very successfully accomplished, and Celebes is now no longer the worst-represented part of the world in the Museum collections, as was formerly the case—an improvement wholly due to those who have already made Northern Borneo the best-represented part of the world in the same collections.

In spite of the many Celebean species previously described, most of which have now been obtained, no less than five new ones have also been discovered—a result the more surprising as the Hoses were working in what was supposed to be the best-known part of Celebes.

Besides the Hose and Everett specimens, a bat obtained by Governor Creagh at Sandakan, N. Borneo, is also described, as also is a very remarkable new fruit-bat which occurs in Mr. John Whitehead's last collection from the Philippines.

Boneia menadensis, sp. n.

Size of *Boneia bidens*, Jent. Ears of medium length, sharply pointed above, their outer edge with a small lobule basally. Wings from the sides of the back as in typical *Xantharpyia*. Colour above of head dark smoky brown, of nape dull yellow, of back dark reddish brown, gradually becoming paler and brighter on the rump. Sides of neck with dark golden gland-tufts. Chin, throat, and belly pale greyish brown. Wings and limbs naked, except just on the proximal part of the forearm and on the femora and neighbouring parts of the interfemoral membrane.

Skull with a broad heavy muzzle and strong widely expanded zygomata. Premaxillæ separated in front.

Upper incisors two in number, short, cylindrical, equidistant from each other and the canines. Canines long, grooved in front. First upper premolar small, but not specially crushed in between the canine and second premolar. Lower incisors in an even curved row between the canines, the outer four or five times as stout as the inner ones. Canines short, stout, and strongly slanted outwards.

Dimensions of the type (an adult male skin):—

Forearm 97 millim. (=3·8 inches); head and body (approximate) 153; ear (dried) 20; lower leg 53.

Skull: extreme length from nasion to occiput 43·7; greatest breadth 25; tip of nasals to supraorbital foramina 20; interorbital breadth 7·5; tip to tip of postorbital processes 16; front of upper canine to back of $\frac{m}{2}$ 15·1.

Hab. Menado, Celebes.

Coll. C. and E. Hose, Oct. 1895.

This bat is probably the N. Celebes representative of the southern *B. bidens*, from which it may be distinguished by the distance between the dorsal origins of the wings, its pointed ears, and different colour, notably the brown instead of "golden-yellow" crown.

HARPYIONYCTERIS, gen. nov.

Index with a claw. Wings from the sides of the hairy back, inserted behind at the junction of the first and second toes. No tail. Hind limbs apparently very short. Inter-femoral membrane obsolete, buried in thick fur.

Dentition.—I. $\frac{1}{1 \text{ or } 0}$, C. $\frac{1}{1}$, P. $\frac{3}{3}$, M. $\frac{2}{2} \times 2 = 28$ or 30.

Upper incisors large, touching each other and the canines, shaped, when viewed in front, almost like those of *Desmodus*, each with a long oblique cusp touching its fellow in the middle line of the skull, but in section each is broadly triangular, with a broad posterior basal ledge. Canines with a large posterior secondary cusp about half as high as the main cusp, and with a broad postero-internal basal ledge, but no additional internal cusps; its direction much more slanting forwards than usual, as is the lower canine also, so that the two cross each other nearly at right angles, instead of being approximately parallel. First two premolars about as in *Cynopterus*. Molars oblong in section and of a peculiar cuspidate character, the lateral longitudinal walls to the usual median groove broken up into several minute cusps, none of which are at all specially lengthened. Below, the incisors are practically obsolete, being minute and almost crowded out* by the large canines, which touch each other in the middle line, and each have an antero-internal and a postero-external secondary cusp and a broad posterior ledge.

It is difficult to say with certainty to what previously known genus this remarkable form is most nearly allied. Its peculiar canines to a certain extent recall those of *Harpyia*, but this resemblance may be either accidental or due to their common descent from the (presumably) cuspidate-toothed ancestors of the Pteropodidæ†. On the whole it may be most conveniently placed near *Xantharpyia* and *Boneia*, with which it shares certain external characters, an indical claw, and the cheek-tooth formula of P. $\frac{3}{3}$, M. $\frac{2}{2}$; but the

* In the single type specimen one lower incisor only is present, the other having fallen.

† See P. Z. S. 1888, p. 473.

unique incisors, the short bi- and tricuspidate canines, and the multicuspidate molars separate it widely even from these, and render it one of the most isolated of all the genera of the group.

Harpyionycteris Whiteheadi, sp. n.

Size about as in *Xantharpyia amplexicaudata*. Fur soft, close and woolly, especially posteriorly. General colour of the fur all over above and below a uniform chocolate-brown, a little darker on the face, and a little lighter on the nape and shoulders. Wing-membranes dark, with a few whitish spots scattered about them. Ears of medium length, rounded at their tips. Fur of the back extending thinly on to the forearms and covering the hind limbs densely down to the roots of the claws. Interfemoral membrane barely a tenth of an inch wide, wholly buried in the fur.

Dimensions of the type (an adult skin of doubtful sex):—

Forearm 84 millim. (=3·3 inches); head and body 140; ear 17; index-finger and claw 60; third finger, metacarpal 59, first phalanx 44, second phalanx 54.

Skull: basal length 37·5; greatest breadth 23·8; inter-orbital breadth, tip to tip of postorbital processes 6·9. Front of canine to back of m_2 17.

Hab. Mindoro, Philippines, alt. 5000 feet.

Coll. J. Whitehead, December 1895.

Mr. Whitehead is to be congratulated on this interesting addition to the splendid discoveries he has already made in the Philippine Islands.

Rhinolophus Creaghi, sp. n.

Size medium. Nose-leaf widely different from that of any other species by the fact that while usually, in Dobson's words, the upper margin of the connecting process of the sella is conjoined with the summit of the vertical process at the same level, or exceeds it posteriorly in height, in the present species the connecting process is almost obsolete and is far overtopped by the anterior vertical process. Above the low connecting process, on the front face of the sella, there is a prominent tuft of brown hairs, projecting forwards and overhanging the anterior vertical process. The latter process is spatulate, narrower below, broadening out in the middle, pointed above. Internarial lappets rounded. Horizontal nose-leaf broad, just about covering the muzzle. Lower lip with three grooves. Ears large, sharply pointed

at their tips. Wings from the tibiæ nearly half an inch from the ankle. Colour, as usual, dull brown above and below.

First upper premolar between the well-separated canine and second premolar. Second lower premolar entirely absent.

Dimensions of the type (an adult female in spirit):—

Forearm 49 millim. (=1.95 inch); head and body 51; tail 17.5; ear from notch 22; nose-leaf 15×10 ; lower leg 23.

Hab. Sandakan, British N. Borneo.

Presented and collected by Governor C. V. Creagh, C.M.G., in whose honour I have ventured to name the species.

This very interesting bat differs from all the ordinary members of the genus both by the absence of the second lower premolar and by the characters of its nose-leaf, in which latter respect it shows a certain tendency towards the unique and peculiar *Rh. calophyllus*, Peters. To the best of my belief, no species as yet described resembles *Rh. Creaghi* closely enough to need detailed comparison with it.

Felis domestica, L.

With the various remarkable Murines sent by Mr. Whitehead from Luzon in 1895 there was a cat found living wild at a considerable altitude in the mountains. As it was possible that this was a domestic cat run wild, it was put aside for further evidence on the subject. Now, again, Mr. Everett sends from Mount Bonthain, S. Celebes, a cat obtained at 6500 feet which precisely agrees in every respect with Mr. Whitehead's Luzon animal. On comparing these two mountain skins with two specimens obtained at Makassar by Wallace, and considered ever since as *F. domestica*, I find there is just the difference which might be expected to occur between tame and feral individuals. Indeed, one of Wallace's is almost precisely like Everett's, while the other is obviously a domesticated specimen, and the comparison of the whole series shows conclusively that the mountain-cats both of Luzon and Celebes must be regarded as feral individuals of the ordinary Malay domestic cat. The same conclusion is to be drawn from the skulls, which agree very closely with those of the domestic cat, while quite different from those of *Felis chaus*, to which, if a genuine wild species, the Luzon and Celebes cat would by its colour be most nearly affined.

Among the Muridæ obtained by Messrs. C. and E. Hose the following known species occur, most of them having been previously unrepresented in the Museum collection:—*Mus*

Hellwaldi, Jent., *M. Musschenbroeckii*, Jent., *M. Meyeri*, Jent., *M. celebensis*, Gray, *M. xanthurus*, Gray, *M. callitrichus*, Jent., *M. neglectus*, Jent. (?), *M. ephippium*, Jent., and *Craurothrix** *leucura*, Gray. The skins of the last-named quite agree with the type of "*Echiothrix leucura*," and confirm Dr. Jentink's record of Celebes as the true locality of this remarkable rat.

In addition to these, two new species of *Mus* were obtained, whose descriptions follow:—

Mus fratorum, sp. n.

Size about as in *Mus rattus*. Fur of medium length, soft, without longer bristles intermixed. Ears large, evenly rounded. General colour above brownish grey, finely sprinkled with dull yellowish. Head rather paler, but the circumference of each eye slightly darker. Under surface dirty greyish yellow, the bases of the hairs slaty grey, their tips dull yellowish; line of demarcation on sides little marked. Hind feet rather elongate; fifth hind toe reaching to the middle of the first phalanx of the fourth; upper surface of hands and feet silvery white. Tail somewhat shorter than head and body, finely scaled (about 11 scales to the centimetre), its proximal two thirds above brown, its end and the whole of its under surface white.

Skull with rather a small cranial and long facial portion. Supraorbital beads distinct, although not strong. Front of zygoma-root little projected forwards. Anterior palatal foramina of medium length, not reaching back to the level of m.¹. Molars large and heavy. Bullæ small.

Dimensions of the type (an adult male in skin):—

Head and body 193 millim.; tail 157; hind foot (moistened) 38·8; ear 20.

Skull: basal length 37·5; basilar length to henselion 34·3; greatest breadth 21·2; nasals 19·4 × 4·6; interorbital breadth 6·4, interparietal 5 × 9·5; diastema 12; palate length from henselion 19·2; palatal foramina 7·4 × 3·2; length of upper molar series 7·6; breadth of palate outside m.¹ 9·2, inside m.¹ 4·5.

Hab. Rurúkan, Celebes, 3500 feet.

Coll. Charles and Ernest Hose.

Type killed Oct. 8, 1895.

* *Nom. nov.*

Echiothrix, Gray, P. Z. S. 1867, p. 599, *nec*

Echinothrix, Peters, MB. Akad. Berl. 1853, p. 487 (*Echinodermata*).

Besides the type, there are several other specimens from Rurúkan, two from Menado, and one from Mount Masarang.

This species is apparently most closely allied to *M. chrysocomus*, Hoffm., also a native of Celebes, but differs from it by its larger size, beaded supraorbital edges, and much heavier molars.

Mus minahassæ, sp. n.

General appearance that of the *Mus Margaretæ* of Sarawak, but the structure of the feet quite as in normal *Mus*. Size small. Fur long and soft. Ears of medium length. General colour above rufous, duller on the back, brighter on the sides. Under surface white, bases of the hairs grey; line of demarcation on sides well-marked. Metapodials brown, fingers and toes whitish. Thumb with a large nail, other digits with short, sharp, curved claws. Hallux not opposable, with a claw, reaching without its claw to the base of the second toe; fifth toe reaching to the middle of the second phalanx of the fourth. Soles naked; pads apparently six in number as usual, not striated, the posterior one elongated. Tail long, slender, very finely scaled (23–25 scales to the centimetre), short-haired (the extreme tip is gone, but there is no sign of the commencement of a terminal pencil), uniformly brown above and below.

Skull suggesting that of *Chiropodomys* by its disproportionately large brain-case and small face. Muzzle short and slender. Interorbital region narrow, flat above, its edges square, faintly beaded; parietals large, convex; interparietal large; zygomata very weak and slender, greatest breadth of skull just at their posterior roots; anterior zygoma-root not projected forwards. Palatal foramina small. Molars short, broad and rounded.

Dimensions of the type (an adult female in skin):—

Head and body 77 millim.; tail (extreme tip gone) 105; hind foot (moistened) 20; heel to front of last foot-pad 9.3; ear (dried) 12.7.

Skull: basal length 18.6; basilar length from henselion 17.2; greatest breadth 12.3; nasals 7.1×2.5 ; interorbital breadth 3.8; brain-case, length 13.2, breadth 11.8; interparietal 4.5×8.5 ; diastema 6.1; anterior palatal foramina 2.9; length of upper molar series 3.2.

Hab. Rurúkan, Minahassa, N. Celebes.

Coll. Charles and Ernest Hose, November 1895.

This very pretty little mouse is readily distinguishable from all others by its *Chiropodomys*-like appearance and skull, combined with its strictly *Mus*-like hands and feet.

In South Celebes and the Saleyer Islands, besides several desiderata to the Museum collection, Mr. Everett obtained examples of the two following new species:—

Mus celestis, sp. n.

Size rather less than *Mus fratorum*. Fur long and soft, hairs of back about 18 millim. in length; no longer bristles intermixed.

Muzzle unusually long, cylindrical. Eyes small. Ears large, rounded, laid forward in a spirit-specimen they reach to the anterior canthus of the eye. Palate-ridges 3-5. General colour above rich rufous brown (perhaps, in a bright light, nearest to Ridgway's "hazel"), the hairs dark slate for the greater part of their length and just tipped with rufous. The belly is also of much the same colour, only lighter, and the line of demarcation on sides is quite imperceptible.

Fore feet with the dark colour extending on to the metacarpals, fingers white; claws exceptionally long and strong, little curved, quite different to those of ordinary rats. Hind feet similarly coloured to the fore; claws long and strong; fifth hind toe without claw reaching to the end of the first phalanx of the fourth; pads, as usual, six in number, large and rounded. Mammaræ 0-2=4; clitoris very long and slender. Tail about equal in length to the head and body, finely scaled (about 14 scales to the centimetre), uniformly thinly haired, blackish above, white below, the two colours intergrading on the sides.

Skull less different from that of ordinary rats than the very peculiar external characters would lead one to expect. Muzzle long and cylindrical, slightly concave upwards near the middle of the nasals. Interorbital region very broad, rounded above, its edges slightly beaded. Interparietal narrow antero-posteriorly. Projection of anterior zygoma-root medium. Anterior palatal foramina about the length of the molar series, and narrow, little open, not reaching backwards nearly to the level of $\frac{m-1}{m}$. Bullæ small.

Dimensions of the type (an adult female, in spirit), before skinning:—

Head and body 148 millim.; tail 148; hind foot without claw 34; ear 26.5×18 . Longest fore claw (above) 4.9, longest hind claw 4.6; heel to front of last foot-pad 16.5.

Skull: basal length 36.2; basilar length from henselion 33.7; greatest breadth 19.4; nasals 15.7×3.7 ; interorbital breadth 6.9, interparietal 3.5×9 ; diastema 12.5; palate

length from henselion 19·6; palatal foramina $6·7 \times 2·1$; length of upper molar series 6·6; breadth of palate outside $\frac{m.1}{m.1}$ 8, inside $\frac{m.1}{m.1}$ 4·2.

Hab. Bonthain Peak, S. Celebes, 6000 feet.

Coll. A. H. Everett, October 1895.

This remarkable species differs so much in its external characters from ordinary rats that I have had great doubts whether a special genus or subgenus ought not to be made for its reception. As, however, there do not seem to be any very definite cranial or dental characters, I feel justified in leaving it for the present in the genus *Mus*.

Mus æmuli, sp. n.

Size medium, about halfway between rat and mouse. Fur thickly spinous. General colour greyish brown, finely speckled with rufous. Belly white, the bases of the hairs grey; line of demarcation on sides well defined. Ears almost naked, laid forward in a spirit-specimen they reach to the middle of the eye. Palate-ridges as usual in the group, *i. e.* as figured by Jentink in *Mus Wichmanni**. Mammæ 2—2=8. Hands and feet pure white above; fifth hind toe reaching nearly to the end of the basal phalanx of the fourth; soles naked, with only 5 pads, the ordinary postero-external pad either suppressed or coalesced with that at the base of the fifth toe. Tail long, thinly haired, not pencilled; its scales large (10 to the centimetre), uniformly brown above and below, but the hairs below are white, although they do not hide the brown colour of the scales.

Skull narrow, with the zygomata little expanded. Interorbital space broad, its edges strongly rimmed, the raised ridges running backwards to the hinder edges of the parietals. Interparietal large. Anterior edge of the zygoma-root well projected forwards. Anterior palatine foramina reaching backwards just to the level of the front of $\frac{m.1}{m.1}$. Teeth rather small in proportion to the size of the skull.

Dimensions of the type (an adult male in spirit):—

Head and body 134 millim.; tail 172; hind foot 30; ear 17.

Skull: basal length 30·2; basilar length from henselion 28; greatest breadth 16·5; nasals $12·8 \times 3·9$; interorbital breadth 5·6, interparietal $5·3 \times 10$; zygoma-root 3·5; diastema 9·7;

* Weber's Zool. Ergebn. Niederl. Ost-Indien, Mamm. p. 120, pl. x. fig. 7 (1890).

anterior palatine foramina 6.5×2.7 ; length of upper molar series 5.7.

Hab. Jampea Island, Saleyer group.

Coll. A. H. Everett, Dec. 1895.

A second specimen (female) has its head and body 125 millim., tail 169, hind foot 29.5, and ear 18.

This species seems to be most closely allied to *Mus Becarii*, Jent., from which it differs by its rather larger size or, at least, longer hind feet, the absence of any terminal pencilling to the tail, its grey-mixed belly, white feet, the normal projection forward of the zygoma-root, and the further extension backward of the anterior palatine foramina.

XXXIX.—The Pholadidæ.—II. *Note on the Organization of the Larva, and the Post-larval Development of Ship-worms.*

By C. P. SIGERFOOS*.

A YEAR ago I published† a note on the early stages of development of the Pholadidæ, in which the breeding-habits of *Pholas* and three species of ship-worms were described. During June and July of 1895 I again visited Beaufort, N. C., with the Johns Hopkins Marine Laboratory, and collected all stages of one of these species (*Xylotrya fimbriata*) from the small bivalve that has just become attached to the adult. As the eggs of this species are extruded freely into the water, I have not been able to observe the stages between the oldest larvæ raised in aquaria from artificially fertilized eggs and the attached stage, in which the development is much more advanced. For these intermediate stages it is necessary to resort to species which retain the embryos in the gills.

The free-swimming stage is reached in three hours, and in a day a well-developed shell has been formed. The young of Lamellibranchs develop but slowly, and though we have no direct observations as to the time the ship-worm larva is free-swimming, we may assume, I think, that it is at least a month, it may be two. During this time most of its energies are expended in locomotion, while after it has become attached it may devote all of its energies to forming its burrow and to securing food for itself; so that its rate of growth is very rapid. The larvæ become attached very

* From the 'Johns Hopkins University Circulars' for June 1896, pp. 87-89.

† 'Johns Hopkins University Circulars,' no. 119, June 1895; Ann. & Mag. Nat. Hist. [6] xvi. p. 233 (1895).

freely to boxes hung in the water, and in this way I was able to secure all stages of development and to observe the rate of growth. I have observed as many as thirty to 1 square centim. of surface. Coming in contact with the wood, the larva throws out a single long byssus-thread for attachment, and never again leaves its place. The velum is lost within a few hours, and the transformation of the small bivalve into the ship-worm is begun. The newly attached larva is somewhat less than 2.5 millim. long. In 12 days it has attained a length of 3 millim.; 16 days, 6 millim.; 20 days, 11 millim.; 30 days, 63 millim.; and 36 days, about 100 millim., when it bears ripe eggs or sperm. In four to five weeks small timbers may be completely ruined in the warm water at Beaufort.

Organization of the Larva.

In striking contrast with the adult, the larva (shown in longitudinal vertical section in fig. 1) is perhaps more fore-shortened than that of any other Lamellibranch. The valves of the shell are elliptical in outline, somewhat wider than long. Seen dorsally they are circular in outline. The left valve bears two teeth, the right three. The long internal process of later stages (apophysis) is present as a rudiment.

The velum still occupies a large space (*VC*) in the anterior dorsal region. I have never seen it extended after the larva had become attached. Both siphons (*A* and *R*) are already formed, and from their point of union the septum has grown forwards and become attached to the foot. The gills of this stage have developed but little beyond the last stage figured by Hatschek. There are on either side two gill-slits, with a rudiment of a third. The "filaments" are true gill-bars, for they are attached to the foot by their ventral end.

The foot is present as a very long tongue-shaped structure, with a byssus apparatus at its posterior ventral angle. In fig. 1 the foot is shown considerably contracted, occupied mostly by mucus-cells and the byssus apparatus.

The retractors of the foot are attached to the umbonal region of the valves. Both adductor muscles are present, the posterior already the larger of the two (*Aa* and *Ap*).

The nervous system is already highly developed (figs. 1 and 2). All of the ganglia are well formed, and the commissures form well-defined nerves. *The cerebral and pleural ganglia are still separated by a short commissure.* The pleural (*Pl*) is lateral to the cerebral (*C*), and from its posterior angle the pleuro-visceral commissure passes. The pedals

Fig. 1.

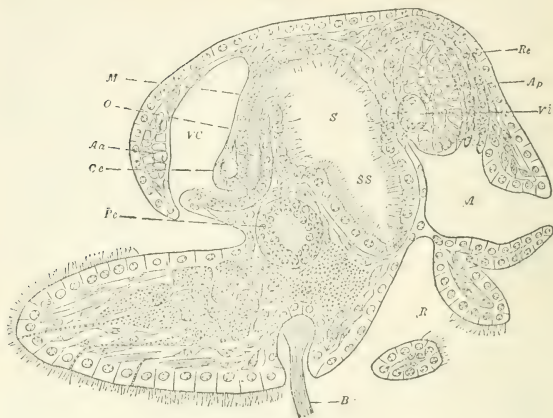


Fig. 2.

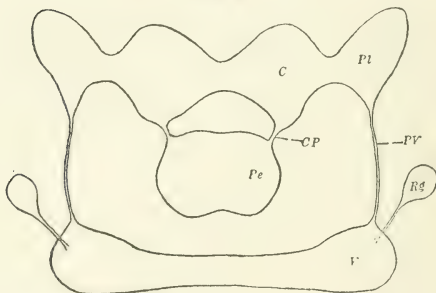


Fig. 1.—Longitudinal vertical section of newly attached ship-worm.
The disintegrated cells of the velum are not shown.

Fig. 2.—Outlines of the ganglia of nervous system, dorsal view. Only commissural nerves are shown.

- A. Anal siphon.
- Aa. Anterior adductor muscle.
- Ap. Posterior adductor muscle.
- B. Byssus thread.
- C. Cerebral ganglion.
- Ce. Cerebral commissure.
- Cp. Cerebro-pedal commissure.
- M. Basement-membrane of velum.
- O. Œsophagus.

- Pe. Pedal ganglion.
- Pl. Pleural ganglion.
- R. Respiratory siphon.
- Rg. Ganglion of respiratory nerve.
- S. Stomach.
- SS. Sheath of crystalline style.
- V. Visceral ganglion.
- Vi. Visceral commissure.
- Vc. Velar cavity.

(*Pe*) are as much concentrated as they will become. The otoliths lie lateral to their posterior edges and persist to the adult condition. The visceral ganglia (*V*) are still wide apart and lie in front of the posterior adductor muscle (*Vi*). With their commissure they form a cylindrical mass four or five times as long as its diameter and somewhat enlarged at the two ends, the ganglia proper. The ganglion of the respiratory nerve (*Rg*) is still wide apart from the visceral.

The alimentary canal is already highly specialized. A rather long œsophagus (*O*) leads into the stomach (*S*), on either side of which a single liver-lobule is borne. From the posterior part of the stomach the sheath of the crystalline style (*SS*) has grown, and, though small, its wall is already composed of large, clear, slightly granular cells, bearing long dense cilia. The intestine leaves the right side of the stomach in front, forms a single loop, and bends upwards and backwards to hang over the posterior adductor (*Re*). From the middle of the right side of the stomach the cæcum has grown as a small hemispherical bag, though it is still functionless.

The renal organs are present and lie ventral to and in front of the posterior adductor muscle. Near the cerebral ganglion on either side is a glandular structure which I shall describe later.

Metamorphosis and Adult Structure.

Once attached, the larva probably never leaves its place. The velum is very soon lost, and has an interesting fate. The long lower lip is thrown forward to the mantle in front under the velar cavity, so that the cells of the velum which are *cast off* have but one mode of escape, into the œsophagus. *They break off* from the basement membrane and *are eaten*. Within a few hours the membrane contracts so as to wholly obliterate the velar cavity. This fate of the velum is interesting, for it has been described as entering into the formation of the labial palps. But in this species there are no palps, and it would not do to generalize to other forms. However, in the oyster, where the palps become very large, they are very small at first, much smaller than the velum, though they are not developed till after the oyster has become attached.

The foot very soon (within a day) becomes the pestle-shaped cupping organ, which assists the shell in boring. The byssus apparatus is functional for a day or two, and then degenerates, though it persists in the posterior part of the foot as a small closed vesicle, as in *Cyclas*.

The burrow is formed as follows:—Almost as soon as the larva has settled it begins to clear away a place by means of the ventral edges of the valves of the shell. In this way a small pit is formed. But very soon rows of teeth are formed in succession on the anterior edges of the valves; the small knobs are formed on their umbonal and ventral regions; the ligament becomes functionless, and the two adductors become antagonistic to each other. The teeth are formed independently, and afterwards are cemented to the valves, pointing outward and backward. While the foot performs a cupping action, the posterior adductor contracts, the two valves swing on each other by means of the two pivots formed by the knobs, and the teeth are brought to bear on the wood, rasping away its surface.

The essential changes in the nervous system are the fusion of cerebral and pleural ganglia and the concentration of the viscerals and their shifting in position. The cerebrals and pleurals have fused in specimens 5 millim. long, but their double origin is still indicated. The visceral ganglia become concentrated in specimens 1 millim. long, and shift from a position anterior to the posterior adductor to one ventral to it, and at last come to lie far behind it in the adult. It seems interesting that the description of the nervous system given by Quatrefages * is still accepted, except with slight modifications in the viscerals as given by Pelseneer. Quatrefages described the cerebral ganglia as fused, the pedals as rudimentary and separate. On this ground, with others, he proposed to separate the Teredidæ from the Pholadidæ. He mistook the pedal for the cerebral, but I am unable to say what he described as the pedal. The pedals are fused from the first and never become rudimentary, though their development is not nearly so great as that of the visceral. The cerebro-pleurals remain separated by a *long* commissure and lie almost at the sides of the mouth.

The gills of the ship-worms are more specialized and more interesting than has heretofore been supposed. Beginning with the two "filaments" present in the larva, new filaments are added posteriorly by the appearance of slits in the gill-fold. These filaments are in reality bars, for the slits are perforations which do not penetrate to the ventral border of the fold. The fold progressively fuses with the body at its ventral border. In this way a series of bars is formed attached at both ends. This mode of formation persists through life, except that after the tenth (usually) a second

* 'Annales des Sciences Naturelles,' Zool. sér. 3, t. xi.

slit appears ventral to the first, so that each filament is separated from its fellows by double slits. That last formed corresponds to the space between the ascending limbs of adjacent filaments. The first ten filaments, then, have no ascending limbs. Deshayes described * a series of plications in the anterior part of the body, and thought them to be normal structures. These are the first ten filaments formed, which have later become separated from their fellows posteriorly by a great distance, as follows:—When the young *Teredo* is somewhat less than 1 centim. long each gill consists of a long series of about seventy-five filaments, stretching uniformly from the anterior part of the body to the small filaments which have just been formed. But now the ninth or tenth filament broadens (grows in line of the antero-posterior axis of the animal) till in large specimens of the adult the anterior filaments may be separated from the posterior part of the gill by 10 centim. or more. The ciliated furrow described by Deshayes connects the two portions. The epibranchial cavity persists as a long canal between the two parts. Fusions between adjacent filaments of the first ten take place, so as to more or less obliterate the gill-slits.

Contrary to the statement of Quatrefages, there is a single gill (a half ctenidium in modern usage) on either side. This is the internal gill, and the external has wholly disappeared.

Closely associated with the gill is a very prominent glandular structure peculiar to the ship-worms. Deshayes described a special gland in the umbonal region, and surmised its function to the formation of a secretion for softening wood by chemical action. Grobben † did not find it, and questioned its existence. Deshayes also described mucus-glands in the gills, whose secretion he supposed to be for the nutrition of the embryos in these viviparous forms. Both are parts of the same organ. In the newly attached larva there is a considerable glandular structure on either side in the anterior part of the body, whose duct opens under the cerebral ganglion in front of the mouth. As the animal grows the gland grows posteriorly, sending branches into the gill-filaments. As the two parts of the gill become separated, the two parts of the gland remain connected by a long narrow (? functionless) duct, which accompanies the epibranchial canal. Further than this I am at present unable to describe this organ, which is very difficult to study. Since in this species, which does not retain its embryos, the posterior part is present in young

* 'Histoire naturelle des Mollusques.'

† *Arbeiten Zool. Inst. Wien*, Bd. vii. (1886).

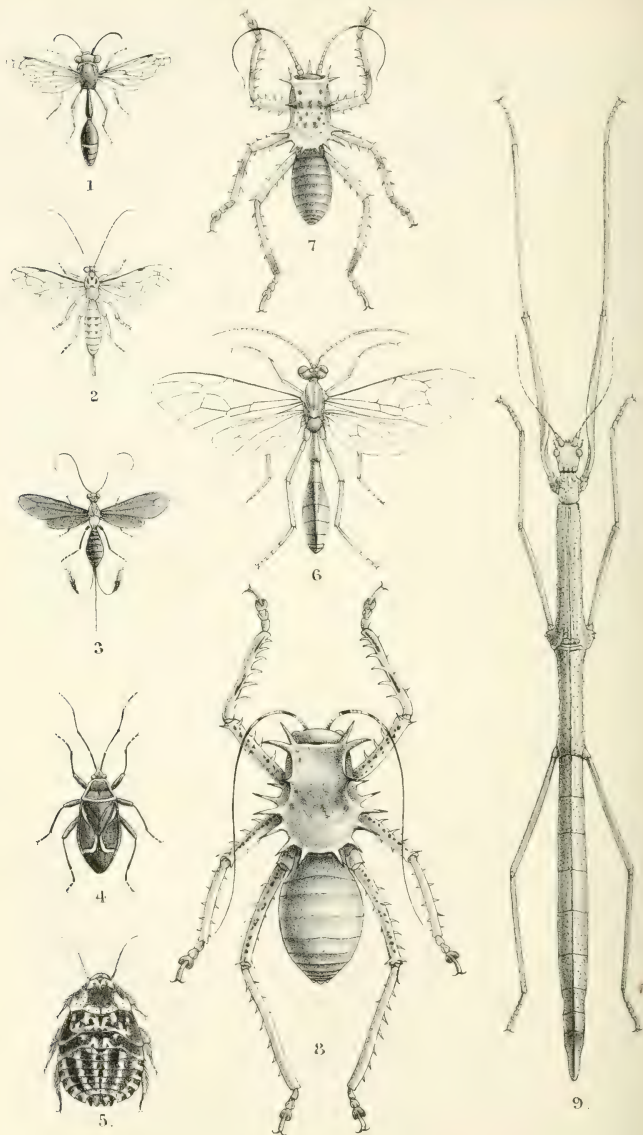
and old and in males and females, its function cannot be the formation of a secretion to nourish the embryos.

The posterior part of the body, usually called the muscular collar, is a very interesting region, containing a complex of several well-defined muscles. The collar is attached to the calcareous tube in an irregularly elliptical line. The outermost part is the line of origin of the *protractor of the pallet*, which radiates from the inner end of the handle of the pallet, its insertion, to its line of attachment. To the inner line is attached the *retractor of the siphons*, which is almost wholly distributed to the respiratory siphon. A well-defined muscle, the *adductor of the pallets*, connects the upper parts of the handles of the pallets. From the upper end of the handle a small muscle, the *retractor of the pallet*, passes to the body forwards. The animal defends itself as follows:—While the siphons are retracted the pallets are protracted to completely close the tube at its outer end. The siphons are extended by an inflow of blood, and the pallets are retracted by the action of their retractors, accompanied by the adductor of the pallets.

In specimens 3 millim. long, in which the visceral ganglia have taken up the position of the adult, the sexual organ is present on either side as a rudiment of a small mass of cells ventral to the ganglia. From this part branches grow out, and the lumen appears later. That in the oldest part of the gland becomes the main part of the genital duct. In addition, there is in the genital papilla a small ectodermal invagination, which much later unites with the part which is of mesodermal origin. The part which is of mesodermal origin forms sexual cells, at least at first. The sexes are separate from the first. Protandry is not present. Only rarely are individuals hermaphrodite.

The ship-worm larva is already highly organized when it becomes attached. A functional byssus apparatus is present. The cells of the velum are cast off and eaten. The cerebral and pleural ganglia are still separate. The crystalline style arises from the posterior part of the stomach. While the foot performs a cupping action to draw the shell close against the surface of the wood, the contraction of the posterior adductor muscle causes the two valves to swing upon each other, and the teeth rasp away the wood.

Contrary to the description of Quatrefages, the pedal ganglia are not separate and not rudimentary; the cerebrals are not fused, but separated by a long commissure. The first-formed filaments of the adult gill have no ascending limbs. They form a series of bars in the anterior region of



the body, separated from the rest of the gill by a long distance. Only the inner gill is present. Anteriorly in the umbonal region, and closely associated with the gill posteriorly, is a prominent organ of unknown function. The sexual duct is mainly of mesodermal origin.

XL.—*A List of the Orthoptera, Hymenoptera, and Hemiptera collected by Miss Kingsley on the River Ogové, with Descriptions of some new Genera and Species.* By W. F. KIRBY, F.L.S., F.E.S., &c., Assistant in Zoological Department, British Museum (Natural History).

[Plate XII.]

THE collection formed by Miss Kingsley, though small, contained several species of considerable interest, in addition to the novelties; and hence I have thought it worth while to prepare a complete list. Eight species in all are here described as new, for two of which it has been necessary to establish new genera. It is, however, to be regretted that in most cases only single specimens were received, and several of them were immature, or the number of new species might have been larger.

Order ORTHOPTERA.

Family Blattidæ.

Subfamily PANCHLORINÆ

TRICHOMERA, gen. nov.

Female.—Apterous; front of head rounded, projecting beyond the prothorax; face hardly oblique; antennæ thickened at base and tapering to tips; prothorax moderately arched, the hinder angles rounded off, those of the meso- and metathorax less rounded and more produced backwards; tibiæ strongly spined above, but femora with no spines, but only clothed with fine hair; abdomen very broad, supra-anal plate triangularly emarginate at the extremity to nearly half its length; cerci very broad, pointed at the end, and a little shorter than the supra-anal lamina.

The unarmed femora place this genus in the Panchlorinæ, but in shape it resembles the females of some of the Blattinæ. The male is probably winged.

Trichomera insignata, sp. n. (Pl. XII. fig. 5.)

Long. corp. 20–21 millim., lat. 13 millim.

Female.—Blackish, with testaceous markings; face nearly smooth, shining black below the vertex, the sides, mouth, and a band within the eyes and antennæ testaceous; vertex testaceous in front, with blackish streaks projecting into it from behind; head and thorax clothed with fine down; prothorax and sides of meso- and metathorax finely punctured, middle of meso- and metathorax and abdomen rather coarsely granulated; mesothorax testaceous, somewhat speckled with reddish brown, the centre filled up with a large blackish blotch, with two projecting angles on each side in front and behind, the two innermost of the hinder projections extending to the hinder margin of the prothorax, and the second of the front projections connected with a large oblong black patch bordering part of the sides of the prothorax; meso- and metathorax bordered on the sides with reddish brown and with several irregular testaceous markings; on the abdomen these are continued more regularly, forming a central and nearly parallel series, and two outer series, the first of which is nearly straight and the second connected with the testaceous border below the lateral angles of the segments; supranal plate black, with a broad testaceous band on each side; cerci black; antennæ reddish, shading into brown; pectus testaceous; abdomen brown beneath.

Two specimens obtained.

Family **Mantidæ**.Subfamily *MANTINÆ*.*HIERODULA*, Burm.

A single immature specimen of this genus, remarkable for the very heavy black band on the front femora and tibiæ and for the black spines of the latter.

Family **Phasmidæ**.Subfamily *PALOPHINÆ*.*Palophus centaurus*.

Palophus centaurus, Westw. Cat. Phasm. p. 91. n. 233, pl. xxxii. fig. 1 (1859); Brogn. Nouv. Arch. Mus. Paris, (3) iii. p. 195, pl. viii., pl. ix. figs. 1–4 (1892).

One of the largest winged African Phasmidæ. A single female specimen was in the collection.

Subfamily PHASMINÆ.

BATHYCHARAX, gen. nov.

Female.—Apterous, rather stout, granulated; antennæ rather shorter than the front femora, 23-jointed, with most of the joints long and cylindrical; scape flattened, about twice as long as broad, second joint also longer than broad and considerably longer than the following joints; front legs much longer and front femora much thicker than in the last two pairs of legs.

Readily distinguished from *Phasma* (*Bacillus* auct.) by the granulated body and the cylindrical joints of the antennæ.

Bathycharax granulatus, sp. n. (Pl. XII. fig. 9.)

Uniform brown, except that the face is varied above with black and below with yellow. Head with a row of 4 raised tubercles behind; pronotum with 3 imperfectly formed grooves and a transverse one dividing it nearly equally; there is also a distinct carina on each side; mesonotum thickly granulated and with 3 central carinæ, the lateral ones not extending to its extremity, but the central one continued along the metanotum and abdomen; abdomen with segments 2-8 (counting the median segment as 1) gradually diminishing in length; ninth short and transverse; tenth three times as long as broad, gradually tapering, and extending for half its length beyond the operculum; cerci very short, rather broad and rounded, just projecting on each side at the base of the tenth segment. Under surface of the body carinated throughout on the central line behind the propectus, which is carinated on the sides; most of the hinder part of the body is carinated on the sides both above and below the middle. Legs carinated and sulcated; first joint of front tarsi about as long as all the remaining joints together; first joint of four hinder legs about as long as the terminal joint, the second and third being each about twice as long as the fourth, which is the shortest.

Dimensions.

	millim.
Long. corporis	100
„ antennarum	18
„ capitis	6
„ pronoti	5
„ mesonoti	22
„ metanoti, cum segmento medio ..	17
„ segmenti medii	4

	millim.
Long. segmenti terminali	9
„ femorum anticorum	24
„ „ mediorum	19
„ „ posteriorum	22
„ tibiæ anticarum	26
„ „ mediarum	15
„ „ posteriarum	22

In many particulars this species agrees with the description of *Bacillus Buchholzi*, Gerstaecker, from the Cameroons (Mitth. naturw. Ver. Neu-Vorpommern und Rügen, xiv. p. 99, 1883), but it is much larger, and the structure of the abdomen appears to be very dissimilar in the two insects.

Family Achetidæ.

Subfamily GRYLLOTALPINÆ.

Gryllotalpa africana.

Gryllotalpa africana, Palisot de Beauvois, Ins. Afr. Amér. p. 229, Orth. pl. iii. c. fig. 6 (1805?).

An abundant species throughout the warmer parts of the world.

Family Phasgonuridæ.

Subfamily HETRODINÆ.

Cosmoderus Kingsleyæ, sp. n. (Pl. XII. fig. 7.)

Long. 21–25 millim.

Rufo-testaceous, abdomen inclining to cupreous, especially in the female; face yellowish, slightly varied with red, and with a black spot on each side at the base of the clypeus; antennæ reddish on the basal half, shading into blackish, at least 40-jointed, the scape and second joint thickened, the scape half as long again as broad, the second joint hardly longer than broad, the third joint twice as long as the fourth, the rest tapering and gradually decreasing in length to beyond the middle, when they become longer and more cylindrical; vertex and thorax closely punctured, the latter more coarsely; thorax with two strong spines at the frontal angles, a strong spine on each side, between which runs a raised ridge, and a row of 8 large spines behind. There is one more large spine on each side slightly before the others; on the yellow lower ridge of the thorax most of the spines are red, tipped with black; those on the legs are described in characterizing the genus. The dividing ridge of the thorax is brownish; before

it are two pairs of shallow brownish depressions, and behind it a row of 5 on each side, curving outwards, and 2 or 3 additional pairs in the middle. Abdomen smooth, more or less cupreous, with some scattered punctures towards the end of the segments.

Much resembles *C. erinaceus*, Fairmaire, from the Gaboon, but only half the size. Described from two males and one female, which hardly differ in structure, thus making it probable that the insect alluded to by Dr. Karsch as the female of *Cosmoderus erinaceus* (Berl. ent. Zeitschr. xxxi. p. 59) belongs to a different genus, and not improbably to *Aprophantia*, described below.

The curious wingless insects belonging to the family Hetrodidæ must be very numerous in the warmer parts of Africa. Almost every collection from these regions, however small, furnishes one or more new species if it contains any Orthoptera. I take the opportunity of adding the description of a new genus and species, which appears to have been confounded with *Cosmoderus erinaceus*, in a footnote *.

*

APROPHANTIA, gen. nov.

Allied to *Cosmoderus*, but with longer and more slender legs, the hind tibiæ especially being considerably longer than the others. All the tibiæ sulcated, front tibiæ with conspicuously open foramina. Femora above with a strong pair of terminal spines; femora and tibiæ otherwise unarmed above, but with a double row of very strong spines beneath. Frontal spine very strong; front coxæ spined, and a spine in front of the middle tarsi.

Abdomen smooth; mesothorax raised in the middle, its front angles armed with a large double spine, from which a strong carina runs to the sides of the ridge, where the carina rises into another large spine; the hinder part of the mesothorax is armed with a row of 9 or 10 more strong spines, extending on each side nearly to the level of the front coxæ.

Aprophantia maculata, sp. n. (Pl. XII. fig. 8.)

Long. corp. 38-48 millim.

Testaceous yellow (probably green during life); the tips of the spines, a double row of spots more or less complete on both sides of the femora, and a patch over the foramina on the front tibiæ black. Antennæ testaceous, with 5 long black bands increasing in length, the last terminal. Male with some obsolete brown markings on the face, two running up from above the frontal horn, and one on each side beyond, angulated outwards. The male also has some obsolete depressed brown marks on the front and sides of the thorax above, nearly as in the species of true *Cosmoderus*. In the female these markings are wanting, and the colour is darker, especially at the sides of the thorax, the front and back of the abdomen, and towards the extremities of the tibiæ, and along their carinæ. The male has three pairs of spines on the femora beneath and two additional spines on the outer carina of the hind femora, and six pairs

Subfamily *CONOCEPHALINÆ*.*Pseudorhynchus sicarius*.*Pseudorhynchus sicarius*, Serville, Hist. Nat. Ins., Orth. p. 310 (1839).

One specimen.

Subfamily *MECOPODINÆ*.*Macroscirtes kangaroo*.*Macroscirtes kangaroo*, Pictet, Mém. Soc. Genève, xxx. (6) p. 14, pl. iii. fig. 38 (1888).

One specimen of this curious long-legged insect.

Family *Locustidæ*.*PÆCILOCERA*, Serv.

A single immature specimen probably belonging to this genus.

Cyrtacanthacris ruficornis.*Gryllus ruficornis*, Fabr. Ent. Syst. ii. p. 54. n. 28 (1793).

One of the great migratory locusts of Africa. The description of Fabricius seems to have been taken from an unusually dark specimen.

Order HYMENOPTERA.

Section TEREBRANTIA.

Subsection ENTOMOPHAGA.

Family *Braconidæ*.*Bracon plumosus*, sp. n. (Pl. XII. fig. 3.)

Long. corp. 11 millim.; long. ovip. 10 millim.

Female.—Head, antennæ, and abdomen (including the petiole) black above; head beneath and mouth-parts fulvous; mandibles bidentate and tipped with black; thorax wholly rufous. Front legs: coxæ and base of femora rufous, the rest wanting; middle legs rufous, tarsi and tibiæ above

of spines on the four front tibiæ, and eight or nine rows of spines (not all paired) on the hind tibiæ. The female differs in having five pairs of spines on the hind femora, but the legs are otherwise spined nearly as in the male.

Described from a single pair (♂ and ♀) from the Cameroons.

black; hind legs black, a white spot at the end of the coxæ above and the second joint of the trochanters rufous. Abdomen below white, with a row of 5 long black dashes on each side, the first bifid in front. Ovipositor rufous, partly black towards the extremity; above it are two long and rather stout black setæ, densely plumose beyond the middle, the apical third of the cilia being white; the extreme tip of the setæ is spatulate and whitish beneath. Wings smoky, the transverse nervures bordered with subhyaline.

Probably allied to *B. semiflavus*, Brullé.

Family Ichneumonidæ.

Subfamily Pimplinæ.

Pimpla nigricornis, sp. n. (Pl. XII. fig. 2.)

Long. corp. cum ovip. 15 millim.; ovip. 3 millim.; exp. al. 23 millim.

Female.—Yellow, antennæ and ovipositor black; vertex with a black band covering the ocelli, which is pointed in front and on each side of the frontal ocellus; mesothorax with a large oval black spot on each side, a triangular reddish patch in front, the hinder angle of which is black, and a transverse black patch in front of the raised scutellum; abdomen yellow on the first two segments and shading into light reddish beyond; a large black spot on each side of segments 3–5; the first segment has a slight impression on each side, the five following ones have a deep groove before the extremity; the front of the body is nearly smooth, but the third segment of the abdomen is sparingly, and segments 4–6 heavily, punctured. Legs slightly suffused with reddish; middle femora slightly and hind femora considerably thickened; hind legs much longer than the others and hind tarsi clothed with a blackish pubescence.

One specimen.

Allied to the Indian *P. punctata*, Fabr.

Subfamily Ophioninæ.

Ophion latipenne, sp. n. (Pl. XII. fig. 6.)

Long. corp. 26 millim.; exp. al. 53 millim.; lat. al. ant. 9 millim.

Female.—Rufo-testaceous, slightly pubescent; occiput, antennæ, legs, and especially the sides of the face, slightly more yellowish; eyes slightly emarginate in front just above the antennæ, below the antennæ they are nearly parallel, or

very slightly incurved. Antennæ pubescent, about 50-jointed, joints 3 and 4 annular, joint 5 the longest, the remainder cylindrical, hardly longer than broad in the middle, and gradually tapering and lengthening towards the extremity, the last conical; tips of mandibles black; ocelli very large, filling up the space between the eyes on the vertex, black, except extreme front of the frontal ocellus beneath, and the outer sides of the two hinder ocelli. Thorax and abdomen very finely and closely punctured; mesothorax with two converging lines slightly yellower than the ground-colour, but only carinated at the lateral borders; metathorax also with a middle carina. Abdomen very large, raised, and somewhat compressed laterally. Hind legs longer than the others; all the tibiæ armed with a pair of terminal spines. Wings rather broad, yellowish hyaline, more strongly tinged with yellow at the base and along the costal area of the hind wings, and towards the tip a little smoky, especially on the hind wings. Nervures rufous along the costa and towards the inner margin; otherwise blackish. Anterior wings with 3 bullæ—one on the lower curve of the cell near its extremity, one on the recurrent nervule, and the third on the cross-nervule running upwards from the extremity of the internal nervure.

The Ophionidæ of Africa are rather numerous, but very few have yet been described.

Family **Evaniidæ**.

Evania lævigata.

Evania lævigata, Latr. Gen. Crust. Ins. iii. p. 251 (1807).

The species of this curious genus, though rare in England, are common in many countries, and are believed to be parasitic on cockroaches.

Section ACULEATA.

Subsection HETEROGYNA.

Family **Formicidæ**.

Subfamily *FORMICINÆ*.

Camponotus maculatus.

Formica maculata, Fabr. Spec. Ins. i. p. 491. n. 15 (1781).

A common African species.

Ecophylla virescens.

Formica virescens, Fabr. Syst. Ent. p. 392. n. 9 (1775).

These green ants are found throughout the tropics of the Old World, and form their nests of leaves on trees.

Subfamily *PONERINÆ*.*Anomura molesta.*

Anomura molesta, Gerst. Mon. Akad. Wiss. Berl. 1858, p. 262; Peters's Reise Mossamb., Zool. v. p. 562, pl. xii. fig. 2 (1862).

A species originally described from Mozambique.

Subsection FOSSORES.

Pelopæus spirifex.

Sphex spirifex, Linn. Syst. Nat. (ed. x.) i. p. 570. n. 8 (1758).

A widely distributed species in South Europe and Africa.

Subsection DIPLOPTERA.

Family *Eumenidæ*.*Eumenes decipiens*, sp. n. (Pl. XII. fig. 1.)

Eumenes melanosoma, Smith, MS., nec Sauss.

Long. corp. 15-17 millim.; exp. al. 25-27 millim.

Head black above, the points of the angles within the eyes yellowish; antennæ ferruginous, black above; face ferruginous, very long, beak-like, sometimes yellow, only the mandibles and a space at the base of the clypeus remaining ferruginous. Prothorax red, with a large triangular black spot nearly filling up the hinder angles on each side; mesothorax black; tegulæ large, black, bordered outside with reddish; scutellum black, a short yellow dash running from its extremity between the base of the wings; postscutellum black, with a yellow dot on each side; metathorax black, deeply sulcated in the middle, and forming two long triangles, the points reddish, into which runs an oblique lateral yellow line. Pectus black, red towards the sutures. Petiole and abdomen black, shining, and much more finely punctured than the thorax; petiole rufous beneath and bordered behind above with a pale yellow line. First segment of abdomen bordered behind above with a yellow line, widely interrupted in the middle. Legs rufous, front (and sometimes middle) tibiæ lined with yellowish; tarsi clothed with greyish pubes-

cence, and the four hinder legs more or less blackish above. Wings iridescent purplish subhyaline.

Agrees very closely with the description and figure of the Javan *E. melanosoma*, Sauss., but appears to be distinct. Specimens in the British Museum from Sierra Leone were labelled *E. melanosoma* by the late F. Smith. The species belongs to the group of *E. æthiopica*, Sauss.

Synagris dentata.

Synagris dentata, Sauss. Études Fam. Vesp. i. p. 80, pl. xiii. fig. 3 (1852).

A common African species.

Subsection ANTHOPHILA.

Family Apidæ.

Subfamily MEGACHILINÆ.

Euaspiæ abdominalis.

Thynnus abdominalis, Fabr. Ent. Syst. ii. p. 245. n. 3 (1793).

A single specimen.

Subfamily XYLLOCOPINÆ.

Xylocopa imitator.

Xylocopa imitator, Smith, Cat. Hym. Ins. Brit. Mus. ii. p. 351. n. 35 (1854).

One specimen.

Order HEMIPTERA.

Suborder HETEROPTERA.

Family Scutelleridæ.

Subfamily ARTHIOPTERINÆ.

Plataspis punctata.

Canopus punctatus, Leach, Bowdich, Mus. Ashantee, App. p. 496 (1819); Gray, Griffith's Anim. Kingd. xv. p. 233, pl. xcii. fig. 2 (1832).

A very pretty species.

Brachyplatys pallipes.

Cimex pallipes, Fabr. Spec. Ins. ii. p. 343. n. 26 (1781).

One specimen.

Coptosoma Murrayi (?).

Coptosoma Murrayi, Sign., Thomson, Arch. Ent. ii. p. 271, pl. ii. fig. 2 (1858); Stål, Hem. Afr. i. p. 9 (1864).

Coptosoma hirtella, Stål, Cefv. Vet.-Akad. Förh. 1858, p. 433.

One specimen only.

Subfamily SCUTELLERINÆ.

Sphærocoris ocellatus.

Tetyra ocellata, Klug, Symb. Phys. v. pl. xliii. figs. 1-3 (1834).

A common species in most parts of Africa.

Family Pentatomidæ.

Subfamily PENTATOMINÆ.

Gen. — ?

An undetermined species of Pentatomidæ, superficially resembling *Dolycoris baccarum*, Linn., but with longer and more slender antennæ.

Atelocera serrata.

Halys serrata, Fabr. Syst. Rhyng. p. 181. n. 2 (1803).

One specimen.

Aspongopus, Lap., sp.

An immature specimen, apparently allied to *A. femoralis*, Stål; black, with the tegmina, borders of the abdomen, and femora greenish cupreous, and the last joint of the antennæ rufo-testaceous, except at the base.

Subfamily TESSERATOMINÆ.

Piezosternum mucronatum.

Pentatoma mucronata, Pal. de Beauvois, Ins. Afr. Amér. p. 46, Hémipt. pl. vi. fig. 5 (1805?).

One specimen, considerably smaller than *P. calidum*, Fabr., and agreeing fairly with Palisot de Beauvois's figure quoted above, which I have no doubt was taken from an African specimen, though it has latterly been referred to the American *P. subulatum*. This small form may or may not prove to be distinct from *P. calidum*, for a series would be required to compare the characters; and I therefore provisionally retain Palisot's name for it.

Subfamily *PHYLLOCEPHALINÆ*.

Gen. — ?

An immature specimen, apparently belonging to a new genus near *Macrina*, Amyot.

Family *Coreidæ*.Subfamily *COREINÆ*.*Mygdonia tuberculosa*.

Mictis tuberculosa, Sign. Rev. Zool. 1851, p. 447, pl. xv. fig. 5.

A common West-African species.

Mictis tristator.

Lygæus tristator, Fabr. Syst. Ryng. p. 266. n. 13 (1803).

Two specimens obtained.

Family *Pyrrhocoridæ*.Subfamily *PYRRHOCORINÆ*.*Antilochus submaculatus*, sp. n. (Pl. XII. fig. 4.)

Long. corp. 16 millim.

Head red, occiput and vertex black nearly as far as the base of the antennæ, but upper orbits red; the lower part of the head under the proboscis is blackish, except behind; head with a central groove and rugose-punctate; close to the back is a waved line, the narrow part behind which is finely punctured. Antennæ black, the terminal joint testaceous, brown towards the tip. Scape curved, thicker than the remaining joints, and a little shorter than the second and fourth joints, which are of equal length; third joint rather shorter than the scape. Rostrum extending as far as the hind coxæ; the basal joint grooved. Thorax black, bordered all round with testaceous; the inner edge of the border and the hinder lobe marked with large punctures; front lobe with a central groove and not punctured, except on a narrow triangular space in front. Scutellum and clavus sparingly punctured, corium more thickly; scutellum and tegmina black, clavus bordered with a narrow red line at the base and on the inside; corium rather broadly bordered with rufo-testaceous on the outside, the stripe then crossing to the end of the clavus, and then curving outwards again, leaving the greater part of the centre and the apex black, as is also the

membrane. Legs black; coxæ, trochanters, base and under surface of femora coral-red; tarsi, except the basal joint, yellowish grey below. Pleura black, bordered with testaceous above and in the sutures, and with red below; abdomen coral-red, the first five segments beneath with a long black band on the sides behind.

Allied to *A. bærhaviæ*, Fabr., but very distinct.

Family Reduviidæ.

Subfamily REDUVIINÆ.

Reduvius, Fabr., sp.

An immature specimen.

Family Belostomatidæ.

Hydrocyrius herculeus (?).

Ilyotrephes herculeus, Stål, Cefv. Vet.-Akad. Förh. 1855, p. 46.

Hydrocyrius herculeus, Stål, Hemipt. Afr. iii. p. 181 (1865)

Lambrane.

Agrees fairly with Stål's description, taken from Caffrarian specimens.

EXPLANATION OF PLATE XII.

Fig. 1. *Eumenes decipiens*.

Fig. 2. *Pimpla nigricornis*.

Fig. 3. *Bracon plumosus*.

Fig. 4. *Antilochus submaculatus*.

Fig. 5. *Trichomera insignata*.

Fig. 6. *Ophion latipenne*.

Fig. 7. *Cosmoderus Kingsleyæ*.

Fig. 8. *Aprophantia maculata*.

Fig. 9. *Bathycharax granulatus*.

XLI.—Description of a new *Acomys* from Somaliland.

By OLDFIELD THOMAS.

THE subject of the present description was obtained by Mr. E. Lort Phillips in the spring of 1895, and, with his usual generosity, has been presented by him to the British Museum.

In honour of Mrs. Lort Phillips, who took a considerable share in the collecting done by the expedition, the species may be called

Acomys Louisæ, sp. n.

Size rather small. General colour greyish fawn, not so

blue-grey as *A. cahirinus* or so red as *A. dimidiatus*. Fur scarcely spinous, similar to that of *A. subspinus*, Waterh., quite different from that of all other species. Under surface and limbs pure white. Tail longer than the head and body, uniformly short-haired, nearly white, its upper surface faintly greyer.

Skull with the usual broad beaded interorbital region. Interparietal large, its front edge strongly angular forwards. Palatal foramina extending nearly to the level of the hinder edge of m.¹.

Dimensions of the type (a male in spirit):—

Head and body 65 millim.; tail 79; hind foot 16.1; ear 13.5.

Skull: basal length 19.6; basilar length from henselion 18; greatest breadth 12.7; interorbital breadth 4.4, interparietal 4.8 × 9.4; palate length from henselion 11.7; diastema 6.4; palatal foramina 5.8; length of upper molar series 4.2.

Hab. Henwaina Plain, 40 miles S. of Berbera.

Type B. M. 95.5.28.3. Presented and collected by Mr. E. Lort Phillips.

This pretty little spiny mouse is evidently the Somali representative of the Cape *A. subspinus*, no other known species having the same semispinous fur.

Another *Acomys* from Somaliland is *A. dimidiatus*, Rüpp., which the lamented Prince Ruspoli obtained on the Webbi Habir, and which is mentioned in the account of his collection.

Besides the *Acomys*, two specimens of *Rhinolophus Antinorii*, Dobs., were obtained by Mr. Lort Phillips near Berbera, and these show, as Dobson expected, that the peculiar structure of the tail-tip in the type was a mere individual aberration.

XLII.—The Brood-cavities of the Surinam Toad.

By F. LEYDIG, of Würzburg*.

THE nature of the cell-like cavities in the dorsal integument of the female *Pipa dorsigera*, wherein the young pass through their embryonic development until they attain the adult form, is a question not entirely devoid of importance for the morphologist. The point is, do these cavities represent new formations or invaginations of the integument produced after

* Translated by E. E. Austen from the 'Zoologischer Anzeiger,' Bd. xix. no. 495 (February 3, 1896), pp. 49-54.

the male has spread the spawn on the back of the female *, or do they owe their origin to previously existing structures, the cutaneous glands perhaps, which receive the ova and then by enlargement and transformation become the brood-cavities ?

Passing over the authors who wrote upon the remarkable genus *Pipa* in the second half of last century, since the question that is here raised did not appeal to them, we have first to consider the statements of Mayer, the former Professor of Anatomy in the University of Bonn †, who writes as follows :—" Before the time of oviposition no cells are discernible upon the back, but merely wart-like folds of skin, the interspaces between which probably form the actual cells later on. These cells develop, and are closed by means of a cornea-like operculum." Since there is no mention here of glands, we may well follow other writers in regarding Mayer's words as implying that he considered the alveoli to arise as the result of a kind of invagination of the skin.

Ten years later the same observer examined *Xenopus Boiei*, Wagl., which, as a tongueless Batrachian, is allied to *Pipa dorsigera*, and was even named by Mayer *Pipa africana*, as opposed to *P. americana (dorsigera)* ‡.

Supposing that *Xenopus*, " similarly to *Pipa surinamensis (americana)*, receives her eggs on her back and hatches them," the author proceeds to the structure of the integument : this is stated to be more vascular in the female than in the male or in the common frog, and to be also thicker and firmer. On its inner surface may be seen " innumerable fine pits," which also become visible on the exterior ; but we are told that especially conclusive in favour of the author's view is the fact that in the case of one of the female specimens the skin on the back is peeled off, and that, moreover, one may observe with the naked eye rounded pits, " large enough to contain an egg."

* [Prof. Leydig here alludes to the customary idea of the process as represented in the natural histories. At a meeting of the Zoological Society of London, held on May 5th of the present year, an interesting communication was read from Mr. A. D. Bartlett on the breeding of these toads in the Society's Gardens. The precise manner in which the eggs find their way on to the back of the female has long been a puzzle to naturalists ; and when Mr. Bartlett's observations are published it will be found that the part played by the male in the spreading of the ova on the mother's body is rather a mechanical than an active one, as hitherto supposed.—TRANSL.]

† A. F. J. C. Mayer, " Beiträge zu einer anatomischen Monographie der Gattung *Pipa*," Nov. Act. Leop.-Carol. nat. curios. 1825.

‡ A. F. J. C. Mayer, ' Arbeiten für vergleichende Anatomie ' (Bonn, 1835).

From the above-quoted observations upon "*Pipa americana* and *Pipa africana*" Mayer derives the conception that for the process of the incubation of the eggs in the first place the dorsal epidermis peels off, and that afterwards, when the ova are lying in the cells, a new and thicker epidermis appears to be produced, which then gives rise to the opercula of the cells. We should probably not be mistaken in assuming that the structures which the author terms "pits and little cavities in the skin" are related to the cutaneous glands; and from this we may conclude that he was inclined to regard the larger cutaneous glands as the origin of the subsequent brood-cavities. Yet we are left in doubt upon the point. It is also worthy of note that he derives the opercula of the cavities in two different ways: in the first communication he compares them to the "cornea," according to which they should be composed essentially of connective tissue; while in the second, on the other hand, he declares that they are a part of the epidermis, and consequently they should be of an epithelial nature.

A few decades later Wyman published a memoir on the development of *Pipa americana*, which is not accessible to me; I regret this the more, since the author in question is said to have dealt exhaustively with the subject*. However, it is stated that the result of his investigation tends to show that the formation of the alveoli is traceable "to a process of invagination of the skin."

Much about the same time investigations upon the dorsal integument of *Pipa* were likewise instituted by myself; and as I came to a different conclusion, I venture here to reproduce verbatim the statement I then published†:—

"The honeycomb-like cavities upon the back of *Pipa dorsigera*, in which the development of the young takes place, must be regarded as enormously developed cutaneous glands. I examined a female whose eggs were still in the ovary and another with the embryos already far advanced within the dorsal alveoli. In the former specimen one observed in the dorsal integument the same spherical glands, with narrow efferent ducts through the epidermis, as were seen in the skin upon the rest of the body. As compared with what we find in the case of other Batrachians, the glands are by no means closely packed, but, on the contrary, are somewhat widely separated. Between the glands the skin is elevated into papillæ of varying size. In the case of the second animal the glands in question were no longer present upon the back,

* *Vide* 'Silliman's Journal,' 1854.

† Leydig, 'Lehrbuch der Histologie,' 1857, p. 86.

but instead thereof were seen the large alveoli containing the embryos. The interior of these cavities was clothed with a delicate pavement-epithelium, the connective tissue layer, distinguishable as a separate skin, was pigmented, and in it, moreover, ran bundles of smooth muscles, which otherwise are entirely wanting in the corium."

Among the authors of zoological text-books there is probably not one who has gone so far as to acquire information with reference to the integument of *Pipa* by means of personal investigation; at any rate, these manuals invariably state, in almost precisely the same way, that the skin swells up and forms cells, or that by hypertrophy of the skin special cavities are formed for the ova. The statements made by myself upon the subject have been disregarded.

Pagenstecher* was the first author who did not pass over my assertions, though he did not altogether agree with them, for he adds:—"Even should it not be the glands themselves that develop into the alveoli, nevertheless by elevation of the skin between the adhering ova a condition similar to glandular invaginations would be produced. That this is actually what takes place is shown by the presence of the pavement-epithelium."

The text-books on comparative anatomy, too, do not touch upon the question; Wiedersheim† alone forms an exception, since he writes:—"The alveoli also upon the back of *Pipa dorsigera* are to be regarded as enlarged cutaneous glands." It is true that the author suppresses the fact that he has borrowed this sentence from me, in consequence of which others were led to believe that he was speaking from his own experience, an assumption that incidentally may here be corrected.

Recently, however, an opponent of my view, and a decided one, has appeared in the person of Klinckowström‡, who during a sojourn in Surinam collected a number of these toads from forest-pools in that region, preserved them by various methods, and afterwards subjected them to investigation in the Zootomical Institute of the University of Stockholm. As a result of his studies this investigator states that the alveoli are "simple invaginations" of the skin.

Now, although I am, it is true, not in a position to appeal

* H. A. Pagenstecher, 'Allgemeine Zoologie oder Grundgesetze des thierischen Baues und Lebens' (Berlin, 1881), 4. Theil, p. 732.

† R. Wiedersheim, 'Lehrbuch der vergleichenden Anatomie der Wirbelthiere,' 2. Auflage (Jena, 1886).

‡ A. von Klinckowström, "Zur Anatomie der *Pipa americana*: Integument," Zool. Jahrbücher, Abth. f. Anat. u. Ontogenie der Thiere, 7. Bd.

to fresh investigations of my own, I nevertheless consider that I may abide by my formerly published interpretation; and in this I am confirmed not merely by what I have learned from a multitude of subsequent investigations upon the structure of the cutaneous glands in other Amphibia*, but even, in addition to this, by the fresh facts adduced by Klinekowström.

In the first place, it can hardly be denied that great agreement prevails between the structure of the alveoli and that of the dark or "poison"-glands, which extends, for instance, to the pigmentation of the wall. The only real point of difference consists in the fact that, as I likewise pointed out at the time, the alveoli are clothed with "a delicate pavement-epithelium," as opposed to the other kind of cellular coating of the cutaneous glands. But such a modification of the elements of the epithelium could still without difficulty be derived from the transition of the gland into the alveolate cavity. With reference to my remark that the smooth muscles which I found in the connective-tissue layer of the environment of the alveoli "are otherwise wanting in the corium," it should be borne in mind that this observation dates from the year 1857. At a later period knowledge of the occurrence of smooth muscles in the corium, on my part also, was further advanced †.

Of especial importance in connexion with the question under discussion is the nature of the operculum. My former short account says nothing as to this part of the cell, probably because at that time I was unable to form a clear idea of its structure—as, moreover, Mayer, as shown above, changed his views with regard to it. Klinekowström is the first to be in a position to furnish detailed information as a result of careful investigation.

The author in question points out that the operculum possesses a structure altogether different from that of the surrounding parts. He states that under a strong magnifying-power it represents a disk of "corneous matter," and exhibits a horizontal striation, which may even assume the appearance of a fibrillar structure; that, from the nature of the insertion of the operculum into the margin of the alveolus and other physical properties, the structure gives rise to the impression that it has proceeded from a substance which was originally of a slimy viscid nature and subsequently

* I gave a final *résumé* of my papers devoted to the cutaneous gland of Amphibia in "Zum Integument niederer Wirbelthiere," 'Biologisches Centralblatt,' 1892, p. 458.

† Cf. *op. cit.* ('Biologisches Centralblatt,' 1892, p. 451).

hardened. We are told that the origin of the operculum is very difficult to explain, that it represents a formation "*sui generis*," and that its "finely striated horn- or chitin-like substance" is to be derived from no part of the integument. In order to remove the difficulties as to the origin of the operculum, the author suggests the possibility that it may arise from the envelopes of the egg which is placed upon the back of the female at the time of sexual congress.

If, in opposition to these statements of Klineckowström, we allow my interpretation to stand, in accordance with which the alveolus is originally an enlarged cutaneous gland, the matter is settled in a simpler manner; for it was repeatedly pointed out by me that in the cutaneous glands of the Batrachians the secretion, in consequence of thickening and hardening, forms a kind of plug, which remains in the orifice of the gland. I regard this "plug" of the cutaneous glands and the "operculum" of the alveoli as equivalent formations; the operculum is, in my opinion, a plug of secretion developed superficially. By this assumption the idea that the operculum is a structure of a special kind is disposed of.

Furthermore, in opposition to the view that the alveolus arises through invagination of the integument, it might be asserted that, were this correct, small mucus-glands must still be present in the wall of the alveolus, since these must be involved in the process of invagination of whole portions of the skin; yet no trace of such is visible.

In conclusion, one may perhaps also recall the fact that a process to some extent corresponding to the formation of alveoli in *Pipa* takes place elsewhere in the case of Mammals. Here, also, in the formation of the placenta the sprouting tufts of the chorion do not grow into newly arising depressions in the mucous membrane, but into the ducts of the uterine glands, which were already in existence and now undergo further modification.

MISCELLANEOUS.

The Bot-fly of the Indian Elephant.

At a meeting of the Mathematical and Natural Science Section of the Imperial Academy of Sciences of Vienna held on July 2nd, 1896, a communication was made by Prof. Friedr. Brauer to the effect that, in conjunction with Herr Anton Handlirsch and with the courteous cooperation of Herr Alois Kraus, Inspector of the Imperial

Menagerie at Schönbrunn, he had succeeded in breeding out the æstrid of the Indian elephant (*Cobboldia elephantis*, Cob.), which was hitherto known only in the larval state. Since it is the intention of Prof. Brauer to furnish fuller details later in a special memoir, he contents himself with giving the following short diagnosis of the genus and species in the perfect condition:—

Genus COBBOLDIA, Brauer.

Head vesicular, with strongly projecting front. Antennæ extremely prominent, owing to the large hatchet-shaped third joint, with fine and bare arista. Beneath the antennæ a very broad and deep heart-shaped antennary pit, without a septum, extending to the oral margin; therefore the facial ridge very short between the facial angles ("Vibrissenecken"). Oral cavity deep, the rudiment of the proboscis fairly well developed, as in *Cephenomyia*, with large claviform palpi. Face and cheeks shining, bearing tubercles ("schwielig"). Ocelli present, eyes bare. Thoracic suture complete. Wings large. Apical transverse vein present, posterior transverse vein nearer to the angle of the third vein than to the small transverse vein; angle of the third vein V-shaped, without projecting stump: first posterior cell open. Alula of moderate size, squamæ very large. Clavi and pulvilli moderately large. Legs slender, short; first tarsal joint as long as all the others put together. Abdomen elongate, oval, in the male with forceps-shaped hypopygium tucked under it; in the female the ovipositor straight, telescopic, chitinous, divided into four segments (when protruded half as long as the body). Ventral plates triangular, separated from the dorsal ones by a broad membrane. Fifth plate cleft in the male. Macrochaetae absent. Hypopleuræ with a row of hairs.

Spec. *Cobboldia elephantis*, Cob.

Gastrophilus elephantis, Cob. olim (from the larva), Trans. Linn. Soc. 1881.

Cobboldia elephantis, Brauer (from the larva), Wien. ent. Z. 1887.

Black, short and thickly clothed with hair; head and antennæ reddish yellow; proboscis and palpi black. Wings dark, blackish blue, metallic; basal cells, alulae, and squamæ snow-white. Halteres and legs black. On the head and on the margins of the abdominal segments silvery white reflexions. In general appearance resembling a *Pharyngomyia*. Female with the front broader and the ovipositor black; otherwise precisely like the male.

Length of body 12–14 millim.

Length of wing 10–11 millim.

The larvæ leave the host in the early hours of the morning, pupate in from one to two days, and the imago appears sixteen days after the exit of the larvæ. Copulation takes place immediately.—*Sitzungsb. kais. Akad. der Wiss. Wien*, Jahrg. 1896, no. xvii. pp. 180–182.

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XLIII.—*The Development of a Termite*—*Eutermes* (Rippertii ?) : a Preliminary Abstract. By H. McE. KNOWER *.

DURING my tenure of the Adam T. Bruce Fellowship this past winter I have studied the development of a species of termite closely related to *Eutermes Rippertii*, Rambur. The material was collected in Jamaica, and the work was undertaken as part of a more extended investigation of the biology of the Termites and because of the primitive character of the group, the embryology of which has not been hitherto studied.

In its general features the embryology is quite similar to that described by Brandt for the Libellulid *Calopteryx* (1) ; but, on the whole, I should say it resembles rather more the development of certain of the Orthoptera. Like *Stenobothrus*, *Æcanthus*, &c., the first rudiment of the embryo is a small disk near one pole of the egg. In the termite this disk is on the ventral surface, just beneath the micropyles, near the posterior pole of the egg. I have studied the segmentation and early stages of the formation of the disk to find out how this rudiment arises. As a result, it is clear to me that the germ-disk is not formed immediately during the segmentation, by cells wandering from the interior of the egg directly to their places in the embryonic area. On the contrary, the cells

* From the 'Johns Hopkins University Circulars' for June 1896, pp. 86, 87.

resulting from segmentation become about equally distributed to all parts of the egg. At an early stage most of the cells have reached the surface of the yolk, only very few remaining behind as vitellophags. After attaining the surface the cells of the blastoderm (it may, perhaps, be spoken of by this term, though protoplasmic continuity between its cells cannot be shown) continue to divide at all points, though the nuclei in the posterior end divide more rapidly. For a number of stages this becomes more noticeable, but it is also evident that the actively dividing nuclei are not confined to the restricted area on the ventral surface to be occupied by the disk. The nuclei of the dorsal surface near the posterior pole are as numerous and as near together at this time as those on the ventral surface. From this stage to one exhibiting a sharply outlined germ-disk about to be covered by an amnion there is apparently a concentration of the cells on the surface toward the ventral side of the egg to a point just beneath the micropyles. This, as has been said, is the place where the primary rudiment of the embryo is finally situated. Hence the embryonic disk is seen to be due not simply to an active multiplication of the cells of a restricted area of the blastoderm, but likewise to a concentration of the blastoderm-cells. This, it will be remembered, is what McMurrich has recently shown to be true in the development of Isopods (5). A similar concentration has been observed in the establishment of the first rudiment of other insect embryos; but in the termite it is especially marked, owing to the comparatively small size of the germ-disk (see Patten for the Phryganids (6) and Wheeler for *Doryphora* (8)). Sections of the disk during this concentration show that cells are crowded beneath the surface from a very early stage in its formation. This takes place at all points in the area of the disk, and the surface nuclei also divide tangentially here and there to separate cells which adhere to the lower surface. This is the beginning of the formation of the "under-layer."

Surface views of older embryos show two changes in the disk. Near the centre a dark spot appears, and in the same stage the posterior margin becomes marked out as a semicircle of especially closely crowded nuclei. Sections of such disks show that the "under-layer" cells have become more numerous, and have collected into a plug projecting into the yolk and making the dark spot seen on the surface. The posterior semicircle of crowded nuclei represents the first rudiment of the amnio-serosal fold. It is, at this period, merely a more thickened margin of the disk. The area between the central plug and the amnion thickening (if it

may be so spoken of) is quite thin, being a single layer of cells. These stages, as well as later ones, agree in showing no gastrula invagination, the "under-layer" being formed, as described, rather by a process of delamination or in wandering due to crowding, and the plug being a later secondary formation.

The facts of the origin of the "under-layer" support Heymons's (10) recent views as to the formation of this layer in the Orthoptera, in as far as they indicate that invaginate gastrulas may be secondary phenomena among insects.

As to the origin of the amnion. In the termite it is apparently, as has been said, a thickening of the posterior edge of the disk before any trace of a fold can be distinguished in section. When this thickening folds over the disk the amnion is seen to differ in no essential from the rest of the embryonic disk (of course leaving the "under-layer" plug out of consideration).

The enclosure of the germ-disk takes place by the single posterior semicircular fold growing forward to its anterior extremity. Just after the amniotic cavity is closed in this way the amnion is still found to be quite thick and like the upper layers of the disk (see Bruce's figure xliii. of *Mantis* at this stage (2)). A like similarity has been observed in many insects between the ectoderm of the embryo and the amnion.

The further growth of the embryo is much like that figured by Graber for *Stenobothrus* (3). While the anterior end of the disk remains fixed the tail-end grows back over the posterior pole. In this way an embryonic band is formed which makes a cap over this pole. Both ends of the band are at first of the same shape. Soon, however, the anterior extremity spreads out into a broad cephalic area, which has reached its greatest extent by the time the posterior end of the band has pushed up about one third of the dorsal surface of the egg. Segmentation now sets in—the antennary (postoral), mandibular, first and second maxillary, and first thoracic segments appearing almost simultaneously.

There are no macrosomites, as in *Stenobothrus* (Graber). The remaining thoracic and abdominal segments are added successively from before backward, as the band grows still further toward the anterior end of the egg. The labrum appears as a median unpaired fold over the mouth.

Sections of these early stages of the elongating embryonic band show that the "under-layer" does not extend anteriorly beneath the ectoderm, which has spread out anteriorly over the yolk to form the cephalic lobes. Posteriorly, however,

the "under-layer" follows the growth of the ectoderm, which is somewhat more rapid. A sagittal section of a band before segmentation shows the "under-layer" as a single row of cells beneath the anterior portions of the ectoderm, where its cells are sharply marked off from the ectoderm. Beneath the tail-end of such an embryo the "under-layer" cells are collected into a large mass, which is not sharply separated from the ectoderm. Most of the extension of the "lower-layer" is apparently due to the multiplication of its own cells. I have not yet studied the differentiation of this layer, but can state that the endoderm appears after the establishment of segments, and is not formed from vitellophags.

The sections just referred to show well the changes of the amnion until it has become a thin lamella. This is brought about as a result of the anterior and posterior extension of the embryo. The cells of the amnion are pulled out into a single row anteriorly, while posteriorly for some time the membrane retains something of its early appearance. When the tail-end of the germ-band has reached the anterior pole of the egg in its elongation, the abdominal region sinks gradually into the yolk and the posterior extremity coils over ventrally toward the head, giving the embryo an S shape. The appendages have meanwhile grown to nearly their definitive length. The first and second maxillæ are trilobed, and ten rather prominent rudimentary abdominal appendages have appeared. The cephalic region has changed considerably. Just after the appearance of the appendages the lateral margins of the cephalic lobes began to roll up toward the mid-dorsal line. As this process continued a little pocket was formed on either side of the head, which grew gradually larger as the folds of the cephalic lobes approached the median dorsal line. Finally the two lateral pouches fused to form the head-cavity. The antennæ were included in this folding, and hence now enclose a portion of the head-cavity.

When the embryo has reached the stage just described it resembles Brandt's figure 11 of *Calopteryx* (1), but it is not "immersed" in the yolk. It is impossible to say just how long this "inverted" position is maintained. There is, perhaps, a rather short interval before "revolution," which is accomplished as described by Brandt for the Libellulid (that is, judging from preserved specimens). When "revolution" is over the embryo lies with its head at the anterior pole of the egg, while the tail-end lies beneath the micropyles at the posterior pole. The ventral surface of the embryo, as in early stages, lies on the micropylar side of the egg.

I have not studied the development beyond the appear-

ance of appendages, in detail, as yet, but may state that the central nervous system arises from neuroblast cells, as described by Viallanes (7) and Wheeler (9) for certain of the Orthoptera.

I had hoped to make out the history of the reproductive system; but, as far as can be determined, no trace of these organs is developed until sometime after hatching. In the workers and soldiers (nasuti), both larvæ and adult, of this species the reproductive organs are entirely aborted.

In reference to the general bearings of my study of this form I shall have something to say in the paper of which this is a preliminary abstract. It may be said here that I do not regard the Libellulids as the best examples of the ancestral type of development among insects, as has been so prominently claimed of late (4) (Korschelt and Heider). On the contrary, I think that the termite and those Orthoptera having a superficial embryo beginning in a disk which must elongate considerably to attain the definitive number of segments have most nearly adhered to the typical method of development for arthropods, and probably best represent the development of the ancestral insects. My reasons for this cannot be given in this note, but will appear in the full paper.

There is not sufficient space here to discuss the question of the origin of the amnion, but I will say that Wheeler's (9) adaptation to insects of Ryder's theory of a mechanical origin of the membranes of vertebrates seems a most inadequate explanation. (Of course the word "mechanical," as used here, is used in the narrow sense of the term, referring the subject to simply stated conditions of pressure and mechanical strain.) This theory is opposed by what we know of the development of the Crustacea, the Myriopods, and the Apterygota. As far as can be shown, the same conditions of pressure are brought to bear on the developing embryos of these forms as on those of the amniote insects; yet no amnion is formed. In those higher forms of insects, which are characterized by the non-appearance of membranes, their failure to appear is even more marked. Here, in the very face of the conditions stated to be efficient to produce them, no membranes are developed.

The origin of the amnion is in all probability referable to physico-chemical forces; but at present I do not believe the problem can be stated in more definite terms than as follows:—There was a suitable basis among the anamniotic ancestors of winged insects for the formation of membranes, but a further condition was necessary before the amnion should arise. This was a change in the environmental influences, making

it a necessity (perhaps for protection against injury, as Korschelt and Heider suggest (4)) for the embryo to be covered over at an early stage in its development. The physico-chemical forces which led to the origin of this adaptive covering cannot be defined at present, but the result was that as soon as the first rudiment of the embryo, the germ-disk, became established a portion of it folded over the rest and became the amnion. This would occur most readily in forms which, like some Orthoptera and the termite, begin in a small germ-disk. When forms arose among the higher insects as adaptations to special conditions of life the early completion of this process became less important, and in a few extreme cases this led to the degeneration and disappearance of the membranes.

- (1) BRANDT, A.—'Beiträge zur Entwicklungsgeschichte der Libelliden und Hemipteren.' 1869.
- (2) BRUCE, A. T.—'Embryology of Insects and Arachnids.' 1887.
- (3) GRABER, V.—'Vergleichende Studien am Keimstreif der Insecten.' 1890.
- (4) KORSCHULT und HEIDER.—'Lehrbuch der vergleichenden Entwicklungsgeschichte.' 1890.
- (5) McMURRICH, J. P.—'Embryology of Isopod Crustacea.' 1895.
- (6) PATTEN, WM.—'The Development of Phryganids.' 1884.
- (7) VIALLANES, H.—'Sur quelques points de l'histoire du développement Embryonnaire de la Mante religieuse.' 1889-90.
- (8) WHEELER, W. M.—'The Embryology of *Blatta germanica* and *Doryphora decemlineata*.' 1890.
- (9) WHEELER, W. M.—'Contributions to Insect Embryology.' 1893.
- (10) HEYMONS.—'Development of Orthoptera and Dermaptera.' 1895. (Abstracted in Journ. Micr. Soc. 1894.)

XLIV.—*Contributions from the New Mexico Biological Station.*
 —I. *Descriptions of new Bees collected by Prof. C. H. T. Townsend in the State of Vera Cruz.* By T. D. A. COCKERELL.

WHEN Prof. Townsend lately went for a collecting trip in Mexico I pointed out to him that, although many bees had been described from that country, we were totally ignorant of their habits, the flowers they visited, and so forth. Accordingly he collected a large series of specimens, noting in every case the exact locality and date, and preserving specimens of the flowers on which the bees were caught. The collection thus brought together is of great interest, not only for the

new species it contains, but for the light it throws on the natural history of a number of those described by Smith, Cresson, and others. At the present time only descriptions are offered; but a future paper will contain the determination of the plants, with lists of species visiting them, and various remarks on the bee-fauna of Vera Cruz.

The two localities cited—San Rafael and Paso de Telaya—are only about two miles apart, both on the north bank of the Rio Nautla, not over 30 to 40 feet above sea-level. San Rafael is about 4 or 5 miles from the coast in a straight line and about 75 miles north of Jalapa by road. From Vera Cruz to the mouth of the Rio Nautla is about 70 miles. Coffee, vanilla, coconut, and cacao do well, but mangoes do not ripen well.

(1) *Calliopsis bidentis*, sp. n.

♀. Length 6 millim. Entirely black, the mandibles only rufescent towards tips, very shiny; face densely punctured; thorax closely punctured in front, much more sparsely on middle, extreme base of metathorax minutely roughened. Wings smoky, nervures and stigma dark vandyke-brown. Tegulæ shining, dark testaceous.

♂. Almost or quite as long, but more slender. Patch on upper median margin of labrum, clypeus (except the two black dots and the anterior edge), lateral face-marks, tubercles (with a dark dot), knees, anterior tibiæ in front, and the tarsi more or less, reddish yellow, probably yellow turned reddish by cyanide. The lateral face-marks are narrow, triangular, pointed above, not quite reaching level of antennæ, but ending abruptly below at or near the level of the clypeal dots.

5 ♀, 3 ♂, San Rafael, March 14, 18, and 23; on flowers of *Bidens* and another composite. Paso de Telaya; one ♀, April 8, on a composite.

This species is of Nearctic affinities, being closely allied to those which frequent Compositæ in the United States. It differs:—

(a) From *C. margaritensis* by being a little larger, the flagellum not testaceous beneath, apical margins of abdominal segments not testaceous.

(b) From *C. albitarsis* ♀ at once by the darkened wings, the marginal cell more narrowly and not at all obliquely truncate, and in the first recurrent nervure joining the second submarginal cell one fifth of its length from its base; whereas in *albitarsis* (a Colorado specimen identified by Mr. Fox) it meets the transverso-cubital nervure.

(c) From *C. albitarsis* ♂ (from Sta. Fé) in the darkened wings, the shorter marginal cell, but not in the first recurrent nervure, which in the male *albitarsis* examined agrees with *bidentis* and does not join the transverso-cubital nervure. The lateral face-marks in *albitarsis* are blunt above and produced below, thus different from *bidentis*.

(d) From *C. ornatipes* ♀ in the somewhat smaller size, the very dark stigmata. The scopa on hind legs is exactly as in *ornatipes*.

(e) From *C. ornatipes* ♂ in the wholly dark scape, the labrum with only a light spot, the tibiæ not yellow except the anterior ones in front.

(f) From *C. Rudbeckiæ* ♀ in the shorter second submarginal cell, which receives the first recurrent nervure nearer its base (one third of its length from its base in *Rudbeckiæ*), and in the margins of the abdominal segments not being dark testaceous.

(g) From *C. Rudbeckiæ* ♂ in the absence of the supra-clypeal mark, the lateral face-marks narrower above and not pointed below.

(h) From *C. perlævis* by its much smaller size, &c.

(2) *Megachile chrysophila*, sp. n.

♀. Length about 11 millim. Short and broad; black throughout, including the legs, mandibles, and antennæ. Head rather broad; face and front with rather dense greyish-white hairs, some sparse, darker, yellowish and blackish hairs converging over clypeus, which is strongly and closely punctured. Supraclypeal area hairless, strongly punctured, except a small, smooth, shining central patch. Cheeks with white hairs. Vertex with rather sparse black hairs. Mandibles bidentate, with a broad inner lamina representing the third tooth; only one groove on outer surface. Thorax very closely punctured, with short sparse inconspicuous pubescence, black and yellowish white mixed, on dorsum, denser and whiter on anterior margin of mesothorax; a conspicuous line of dense yellowish-white pubescence running along suture between mesothorax and scutellum. Pleura and sides of metathorax with white pubescence, dense, so as to form a conspicuous patch beneath the tegulæ. Tegulæ piceous. Wings smoky hyaline, greyish, not yellowish; nervures black. Legs with short, thin, whitish pubescence; basal joints of tarsi with dark rufous pubescence on inner side. Claws not cleft. Abdomen short, subcordiform, rather shiny, closely punctured; hind margins of dorsal segments

with narrow, even, pale fulvous hair-bands. Dark portions with short black pubescence. Apical segment pruinose. Ventral scopa orange-fulvous, mixed with black at extreme apex.

San Rafael, June 20; one, on an orange-flowered composite.

Very near to *M. montezuma*, Cresson, but differs in the black tegulæ, &c.

(3) *Megachile veræcrucis*, sp. n.

♂. Length about or a little over 11 millim. Broad and short; black, legs partly red, all the tarsi pale lemon-yellow. Head of ordinary shape; face densely covered with silky pale yellowish pubescence, flat and directed downwards on clypeus, directed upwards above, with an erect fringe along top of clypeus and thence upwards on each side to the antenna. The light pubescence abruptly terminates just above the level of the anterior ocellus, leaving the vertex with sparse erect yellowish hairs, not concealing the surface, which is densely punctured. A patch behind the summits of the eyes hairless. Cheeks with short, thin, dull subochraceous pubescence, except at extreme base, where it is dense and white. Mandibles wholly black. Antennæ black, the flagellum obscurely ferruginous beneath. First joint of flagellum equal to second; terminal joint broadened and flattened, like a spear-head. Thorax dull and very densely punctured; pubescence above pale ochraceous, short and thin, not concealing the surface, except anterior border of mesothorax, triangularly produced backwards on each side of the middle, a patch above base of wings, anterior border of scutellum, and metathorax, where it is dense. Pleura with fairly dense and long hairs, white on lower part. Tegulæ ferruginous. Wings dusky hyaline, broadly darker on outer margin; nervures fuscous, ferruginous towards base of wing. Coxæ and trochanters black, the anterior ones suffused with reddish. Anterior femora rufous; middle femora rufous in front except base, black behind except apical half below; hind femora black. Anterior tibiæ rufous, the angles more or less black; middle tibiæ rufous, largely suffused with black behind; hind tibiæ dark rufo-fuscous, more or less suffused with rufous. Tarsi all very pale yellow, ends of claws black. Anterior coxæ with a stout spine, fringed with white hairs on inner side; there is a patch of dense white pubescence laterad of the spine, separated from it by a shining smooth space. Anterior femora short and three-sided, the tibiæ also three-sided but shorter. Hind tibiæ in front

covered with very large close pits or punctures. First joint of anterior tarsi broad, flat, thin, convex without, concave within, narrowest at base, not produced at apex, without shining, sparsely clothed with short white hairs; hind margin fringed with long silky dull white hairs, black only at extreme tips, anterior margin within with a short brush of black hairs; inner concave surface black, with white specks. Second to fourth joints of anterior tarsi successively smaller, fringed on hind margin like the first; second with a black spot on inner surface. Median tarsi with the first joint broadly dilated, pyriform, with a dense oblique fringe of silky yellowish-white hairs on outer side, and at base within a deep pit to admit an angular projection of the tibia. Basal joint of hind tarsi somewhat flattened. Abdomen short and broad, rather shining, closely punctured, apical margins of the segments with narrow fringes of pale ochreous hairs. Fifth segment at base and apex largely covered with appressed pale pubescence. Apex emarginate, not very deeply. Base of venter with a strong keel.

San Rafael, June 18; one, on plant no. 29.

Superficially this is much like the male of *M. candida*, Smith, which Prof. Townsend took at Paso de Telaya on April 8. The following table at once separates them:—

M. candida ♂.

Hairs of fringe of first joint of anterior tarsi largely black at ends.

First joint of anterior tarsi not so broad.

First joint of middle tarsi slender, ordinary.

First joint of hind tarsi a little shorter than the three following joints together.

Spines on anterior coxæ longer and more slender.

Tegulæ rufo-piceous.

Second submarginal cell higher.

M. veracrucis ♂.

These hairs black only at extreme tips.

First joint of middle tarsi pyriform.

First joint of hind tarsi distinctly longer than the three following joints together.

Tegulæ ferruginous.

Second submarginal cell very low.

(4) *Megachile perpunctata*, sp. n.

♀. Length about 11 millim. Black throughout, including antennæ, mandibles, and legs. Shape of a *Calioxys*. Face strongly and closely punctured; clypeus with a median smooth line, its median apex trituberculate, with a few dark rufo-fulvous hairs. Pubescence of face and vertex sparse and black, mixed with white in front, and a broad band of white hairs in front of each eye. Cheeks with white pubes-

cence; mandibles tridentate. Thorax dullish, very closely punctured, more sparsely on metathorax, and not at all on the dull enclosure. The surface of the mesothorax, between the punctures, appears to be microscopically tessellate. Pubescence of dorsum of thorax black and very sparse; anterior margins of meso- and metathorax with a narrow band of dense white hairs, but none between scutellum and mesothorax. Sides of metathorax with a white fringe. A spot of dense white pubescence above the tegulæ. Pleura with thin dirty white pubescence. Tegulæ piceous. Wings pale fuliginous, the costa broadly dark fuliginous, shining violaceous; nervures black. Legs with short sparse whitish pubescence; tarsi with shining rufous pubescence on inner side. Claws simple. Abdomen tapering to a point, conical, shining, sparsely punctured, thinly pale pruinose, the first two segments with extremely narrow white hair-bands, first and last segments with a few black hairs. Ventral scopa yellowish white, mixed with black at tip; it cannot be well seen, as it is carrying a great mass of orange pollen.

San Rafael, March 18; one, on plant no. 4.

At first I thought this must be the female of *M. cælioxoides*, Cresson, although that has fulvo-ferruginous legs and is not closely punctured. But Smith describes a female from Orizaba as *M. irritans* which is like *perpunctata*, but has the thorax "finely and not very closely punctured." Thus, if there is any synonymy involved, it must be *irritans*, not *perpunctata*, that is the female of *cælioxoides*.

(5) *Megachile rhodopus*, sp. n.

♀. Length 13 millim. Black, legs and antennæ red. Head ordinary; mandibles dark ferruginous except their ends, which are 3-dentate, outer surface of mandibles with two strong grooves. Pubescence of head and thorax thin and short, ochraceous above, greyish white below and on sides; face with greyish-white pubescence, not dense. Clypeus and front closely punctured; scape punctured; first joint of flagellum not much longer than second. Mesothorax very closely punctured, the punctures fairly large; metathorax strongly punctured, the enclosure very distinct, dull, minutely granular. Tegulæ shining fulvous. Wings hyaline, with a strong yellowish-fulvous tinge, nervures fulvous. Anterior trochanters largely black; anterior femora with a black stripe on outer side. Pubescence of legs sparse and white, becoming fulvescent on tarsi, rufous on inner side of basal joint of tarsi. Basal joint of hind tarsi broad and flat.

Abdomen of ordinary shape, microscopically tessellate, closely punctured; first segment beneath, and following segments slightly at extreme sides, dark rufous. Apical margins of segments 1 to 5 with a band of orange-fulvous hairs—broader, thinner, and erect on first, narrow and appressed on the others. Apical segment with sparse short greyish pubescence, one might say pruinose. Ventral segment 1 without a fringe, 2 and 3 with very long fringes of shining white hairs, fringe of 4 mixed white and black, of 5 black with a few white hairs; extreme apex with pale brownish hairs.

♂. Face densely covered with shining pale yellow silky hairs, an erect fringe of black hairs along top of clypeus; vertex and thorax above with thin foxy-red pubescence. Tegulæ ferruginous. Antennæ black above; apical joint a little flattened and broadened; first joint of flagellum a little shorter than second. Legs largely suffused and blotched with black; tarsi rufous throughout. Anterior legs with a dense long silky fringe behind, the fringe white at base, the long hairs emerging from behind the white ones orange-fulvous. Basal joint of anterior tarsi produced at apex into a long blunt hollow projection; basal joint of middle tarsi ordinary, but with a very long rather thin fringe of yellowish-white hairs on hind border. Spines on anterior coxæ short, flat, and rather broad, blade-like. Hind tibiæ curved. Apex of abdomen broadly, not deeply, emarginate.

San Rafael: the female March 3, on flower no. 1; the males June 18, on flowers nos. 1 and 29. The flowers are Compositæ.

M. rhodopus is allied to certain of the species found in Brazil.

(6) *Megachile bidentis*, sp. n.

♀. Length about 6 millim. With a very short abdomen. Black; head and thorax with thin appressed golden pile, only well seen in certain lights. On each side of the clypeus, and especially along its front edge, the pubescence is denser and conspicuous, pale yellowish. On the front and vertex and beneath each antenna are erect dark fuscous hairs; such hairs are also scattered over the thoracic dorsum, and there are black hairs just before the tegulæ. Head round seen from in front; occiput deeply concave, meeting the vertex at a sharp angle, which continues down the cheeks. Clypeus strongly punctured, but not so densely as the supraclypeal area. Front strongly mammillate. Mandibles very broad, strongly tridentate, wholly black. Antennæ wholly black. Thorax shining in

front, otherwise dull and very closely punctured, seen from the side appearing hardly so large as the head seen from in front. Tegulæ picceous, shining. Wings large for the size of the body; anterior wings 5 millim. long, strongly tinged with reddish yellow, except the portion beyond the cells, which is greyish, the apico-costal margin with a dark grey cloud which extends into marginal cell. Nervures ferruginous; marginal cell broad and rounded at tip, second submarginal very long. Legs shining black, rather slender, very sparsely pubescent; the hairs pale; the hind legs not more pubescent than the others. Inner sides of basal joints of tarsi with dense shining reddish-brown hairs. Abdomen broad and very short, punctured, the first two segments above black, without light hairs, except the hind margin of second segment, which has a narrow fulvous hair-band. Remaining segments covered with appressed fulvo-ochraceous pubescence, that on the third sparse enough to show up the marginal band in contrast. Apex with a broad shallow emargination. Ventral scopa consisting simply of three narrow bands of short fulvo-ochraceous pubescence, hardly fitted to carry pollen, though there is a very little pollen attached to the under surface of the abdomen. Apex with dense pubescence beneath as above.

San Rafael, March 8, on *Bidens*.

A singular little species, very near to *M. pilosa*, Smith, from the Amazons, but differing in colour of tegulæ and of pubescence of abdomen beneath.

(7) *Melissodes pernigra*, sp. n.

♂. Length $12\frac{1}{2}$ millim. Shining, deep black, the pubescence all black, except that on cheeks and pleura beneath it is slightly pallid (dark greyish brown, nearly black), and on inner side of basal joint of all the tarsi it is shining dark rufous. Face about square. Clypeus prominent, arched, wholly dark, its anterior edge shining brownish, its surface microscopically tessellate and beset with close shallow punctures—one might almost say malleate. Mandibles wholly dark. Antennæ long, wholly black, reaching to base of second abdominal segment; scape short and swollen; first joint of flagellum one fourth longer than second. Pubescence of thorax dense but short. Tegulæ black. Wings smoky, nervures black. Short joints of tarsi brown. Abdomen naked above, except base of first segment, which has black pubescence; rather closely punctured; apical third of first

segment impunctate. Ventral segments sparsely fringed with black hairs. Apex truncate.

San Rafael, March 16; Paso de Telaya, March 26, on flowers of *Ipomæa*.

Closely allied to *M. atrata* and *bimaculata*, but differs by the wholly dark clypeus and pubescence. At Paso de Telaya, April 7, on plant no. 9, was taken a female which I am obliged to refer to *atrata*, Smith; but the male of *atrata* was not observed. In the U. S., Robertson has observed the allied *M. bimaculata* visiting *Ipomæa*.

(8) *Melissodes floris*, sp. n.

♂. Length about 9 millim.; antennæ $6\frac{1}{2}$ millim. Black, with pale ochreous pubescence, whitish on lower part of face and cheeks, mixed with black on scutellum, and a few black hairs on hind part of mesothorax; no black hairs on vertex or occiput. Clypeus lemon-yellow, the dots represented by a black notch on each side, anterior edge black. Labrum black. Mandibles dark ferruginous at tips; no yellow spot. Flagellum ferruginous beneath, its first joint about one fourth length of second, not twice as long as funicle. Head broad; pubescence of face, occiput, and cheeks long and fairly abundant. Thorax shining, tolerably closely punctured. Tegulæ dark brown, pubescent. Wings clear, with a slightly yellowish tinge; nervures dark reddish brown. Second submarginal cell not very oblique; third submarginal narrowed at least half to marginal. Legs with thin whitish pubescence, rufous on inner sides of basal joints of tarsi. Claw-joints ferruginous. Abdomen black, the hind margins of the segments broadly testaceous; the surface, especially of segments 3 and 4, more or less pale pruinose; thin subapical white bands of microscopical pubescence on segments 2 to 5, that on 2 sometimes failing in the middle. Base of first segment with long thin pale ochreous pubescence. Dark portions of segments with black hairs. Extreme apex with dark fuscous pubescence. The second segment may show a basal hair-band like the subapical one.

♀. Stouter; antennæ short, reaching only to tegulæ; flagellum only obscurely rufescent beneath; clypeus black, vertex with some black hairs. Wings, perhaps, rather more dusky. Punctuation of mesothorax sparse; abdominal hair-bands on segments 2 to 4 broad, ochreous, that on 2 interrupted broadly in middle, but basal band of 2 conspicuous and entire; fifth segment and apex with greyish-black

pubescence; basal joints of first four tarsi with dense brown-black pubescence on outer side; outer side of median tibiæ with short dark fuscous pubescence; brush of hind tarsi brown-black or sooty.

San Rafael, three males, March 8, 13, and 23, on *Bidens* and another composite; one female, March 8, on *Bidens*.

This is closely allied to the U.S. *M. agilis*, Cresson. They may be separated thus:—

M. agilis ♂.

Front edge of clypeus rufous.

Mandibles with a yellow spot.

No black hairs on dorsum of thorax.

Subapical lateral teeth of abdomen better developed.

9 hooks on costa of hind wing; but this is not constant.

M. floris ♂.

Front edge of clypeus black.

Mandibles without a yellow spot.

Some black hairs on dorsum of thorax.

Subapical teeth less developed, sometimes not noticeable.

11 hooks on costa of hind wing; not constant.

(9) *Melissodes labiatarum*, sp. n.

♂. Length about 11 millim.; antennæ 7. Black; clypeus, labrum, and a small dot on mandibles yellow. Clypeus with the usual two black dots; its anterior margin dark rufous. Flagellum ferruginous beneath, its first joint hardly a quarter length of second, but about twice as long as funicle. Head broad; face, occiput, and cheeks with tolerably dense long yellowish-white hairs, none black on vertex, but occiput behind with black hairs. Mesothorax with rather large, not very close punctures, as also the scutellum, postscutellum, and metathorax. Thorax above with erect, not very long, moderately dense pubescence, pale ochreous varying to dull fulvous, black on prothorax, median hind portion of mesothorax, and scutellum; some long black hairs at sides of metathorax. Where the pubescence is black the shining punctured surface is visible. Pubescence of pleura pale ochraceous. Tegulae black. Wings smoky hyaline, outer margin broadly darker, nervures black; third submarginal cell narrowed about one half to marginal; first transverso-cubital nervure oblique, second bent at its middle. Legs with fulvous pubescence, especially dense and bright on hind tibiæ and tarsi, orange-rufous on basal joints of tarsi within; hind femora above with scattered brown-black hairs. Abdomen black, shining, with thin inconspicuous black pubescence; base of first segment with long pale fulvous or ochraceous pubescence, black at extreme base; second

segment basally with a very thin inconspicuous pale hair-band; extreme sides with rather long pale hairs; ventral segments with thin fringes, centrally black, laterally pale; fifth segment dorsally with an interrupted series of pale hairs; hardly forming a band. Punctuation of abdomen sparse.

Six specimens, San Rafael, March 11; Paso de Telaya, April 7 and 8. Three on no. 27, a labiate; one on flower no. 1.

Seems to be allied to *M. dubitata*, Cresson, from Georgia. It has some superficial resemblance to *Synhalonia atriventris*.

(10) *Melissodes raphaelis*, sp. n.

♂. Length about 10 millim.; antennæ 7 millim. Black; clypeus (except the usual black dots and the more or less rufescent anterior edge), labrum, and a rather obscure spot on mandibles yellow. Flagellum ferruginous beneath, its first joint not longer than funicle and hardly one eighth as long as second. Head broad, face broader than in *labiatarum*. Face, occiput, and cheeks with long but rather thin pale greyish-ochreous pubescence, white on cheeks beneath, slightly mixed with black on sides of face and conspicuously on occiput just behind the ocelli. Thorax shining, strongly but sparsely punctured; median groove of mesothorax distinct. Thoracic pubescence thin, pale greyish ochreous, black on scutellum and disk of mesothorax, mixed with black on sides of metathorax. Tegulæ black, mostly naked. Wings greyish hyaline, darkest apically; nervures black; second submarginal cell oblique, third submarginal narrowed variously one half or two thirds to marginal. Claw-joints rufous, but the claws black except at base. Pubescence of legs thin and pale, rufous on inner sides of basal joints of tarsi, white on outer sides of basal joints of hind tarsi, white in front and black behind on hind tibiae. Abdomen shining, sparsely punctured; base of first segment with erect pale pubescence, bases of remaining segments with broad but thin pale bands of short pubescence, often largely worn away; dark portions with inconspicuous black hairs. Apical segment with a little black or very dark fuscous pubescence. Apical truncation rather broad. Subapical teeth short.

Seven specimens, San Rafael, March 8, 11, 13, and 15; on flowers nos. 1, 7, 5, and 10. The last is an *Ipomœa*.

M. raphaelis will be readily known by the peculiarly

coloured pubescence of hind tibiæ. It is allied to *M. gilensis*, Ckll. ined., from New Mexico*.

(11) *Halictus Townsendi*, sp. n.

♀. Length about 11 millim. Black, with sparse, very pale brownish-grey pubescence. Head broader than thorax, extremely large, subquadrate; cheeks very broad behind the eyes, produced into a blunt spine behind. Eyes small, face nearly twice as broad as the length of an eye. Ocelli close together, the distance between the hind ocelli hardly half the distance between one ocellus and the eye. Vertex and front very closely punctured; clypeus and lower part of face shining, with larger sparse punctures. Mandibles scimitar-shaped,

* While on the subject of *Melissodes*, I will describe a species which, though taken in New Mexico, appears to have Neotropical affinities:—

Melissodes luteicornis, sp. n.

♂. Length $13\frac{1}{2}$ millim.; anterior wing $9\frac{1}{2}$ millim.; antenna 8 millim. Black; pubescence of head, thorax, and basal segment of abdomen bright orange-fulvous, that on thorax rather short but very dense, concealing the surface, not at all intermixed with black. Head broad, face not far from square; ocelli large, placed in only a slight curve; sides of vertex shining; clypeus seen from in front looks naked, large, punctured, bright lemon-yellow, with a black spot, partly hidden by a brush of hairs, on each side. Labrum pale yellow, its apex with a brush of rufous hairs. Mandibles practically simple, obscurely notched within, basal portion broadly pale yellow. Antennæ entirely yellow, except that the funicle and much of the first joint of flagellum are rufescent above, and the whole flagellum is obscurely tinged with rufous above, each joint having a dark dot at its base. First joint of flagellum a very little shorter than second. Tegulæ pubescent. Wings hyaline, nervures fuscous. Legs rather densely covered with pale greyish-ochreous hairs; inner side of tarsi with shining dark rufous hairs. Abdomen stout, black; bases of second and third segments with broad uniform bands of appressed greyish-white pubescence; a similar band on the fourth segment appears dirty grey from the presence of numerous erect black hairs. The rest of the abdomen above, except the first segment, with short black hairs, only conspicuous towards the apex.

Four at Rincon, N. M., July 5, 1896; three at Colorado, a small town near Rincon, July 10, 1896: all at flowers of mesquite (*Prosopis juliflora*, var. *glandulosa*). The student is requested to remember that the locality Colorado has nothing to do with the State of that name.—*M. luteicornis* is a very beautiful species, easily recognized by its yellow antennæ. Its general build is suggestive of *M. obliqua*; but, besides the quite different coloration, the face is broader and the first recurrent nervure joins the second submarginal cell nearer its end than in that species. Judging by the description, Smith's *Tetralonia fervens*, from Chili and La Plata (not Brazil, as Dalla Torre has it), must greatly resemble our species. The antennæ of *fervens*, according to Smith, are bright red; but the antennæ of *luteicornis* turn bright carmine when the bees are left too long in a damp cyanide bottle.

deeply grooved without. Antennæ short, wholly dark; flagellum beneath becoming very dark coffee-brown. Thorax very small, the pubescence only conspicuous on the pleura; mesothorax strongly and very closely punctured; scutellum more sparsely punctured; postscutellum with close smaller punctures. Metathorax finely punctured, the enclosure strongly rugose-cancellate, not bounded by a sharp rim. Tegulae dark mahogany-brown. Wings pale fuliginous; stigma dark dull yellowish brown; nervures fuscous; third submarginal cell narrowed fully one half to marginal. Tibiæ and tarsi with tolerably dense pale fulvous pubescence; hind femora, coxæ, and trochanters beneath with rather copious hairs, which in the type specimen are largely covered with orange pollen. Abdomen only moderately shiny, minutely and very closely punctured; conspicuous bands of appressed dirty white hairs (more or less rubbed off in type specimen) on hind margins of segments 1 to 4, the adjacent bases of the segments also bearing thinner hair-bands.

Another example has the abdominal bands better defined, the bands are narrow on segments 1 and 2, coming almost to a line in middle, but broad, even, and very white on segments 3 and 4. In another the band on segment 1 is broadly interrupted; this last has the hind legs covered with orange pollen.

San Rafael, March 8 and 23, on *Bidens* and another composite.

A very distinct species, allied to *H. ligatus*, which frequents Compositæ in the United States. *H. politus*, Smith, which was also taken at San Rafael, is somewhat similar in general appearance.

(12) *Halictus pseudotegularis*, sp. n.

♀. Length about 5 millim. Head and thorax dark green; abdomen black, pruinose; tegulae black, punctured. This is so near to the U.S. *H. tegularis*, Rob., that a comparative description is needed for its identification:—

H. tegularis ♀.

Face broad, inner orbits arched.

Head and thorax bluish green.

Marginal cell rather longer and second submarginal larger.

Median groove of mesothorax obscure.

Wings clear.

Paso de Telaya, March 29, on *Argemone mexicana*.

H. pseudotegularis ♀.

Face narrow, inner orbits nearly straight.

Head and thorax brassy green.

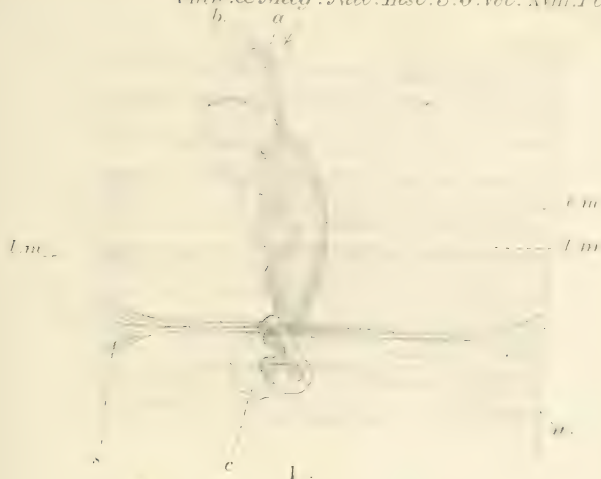
Stigma somewhat darker.

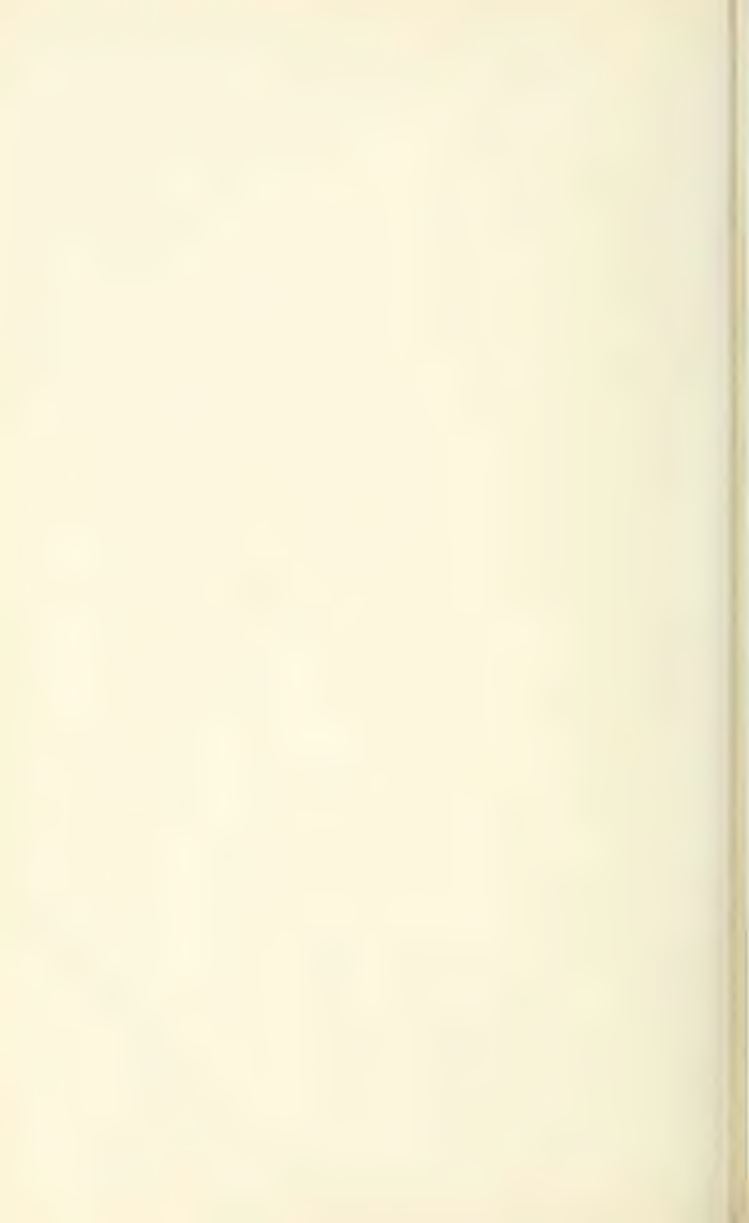
Enclosure of metathorax more triangular, hardly so strongly sculptured.

Abdomen somewhat narrower.

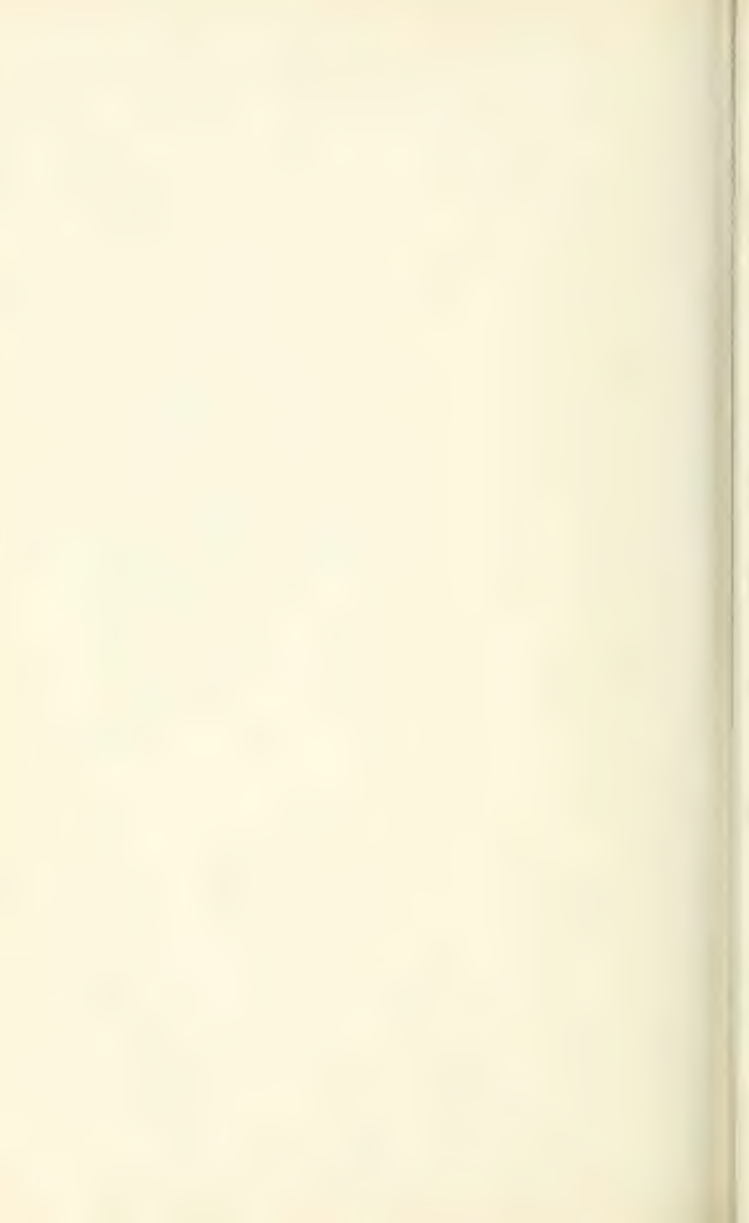
Median groove of mesothorax very distinct.

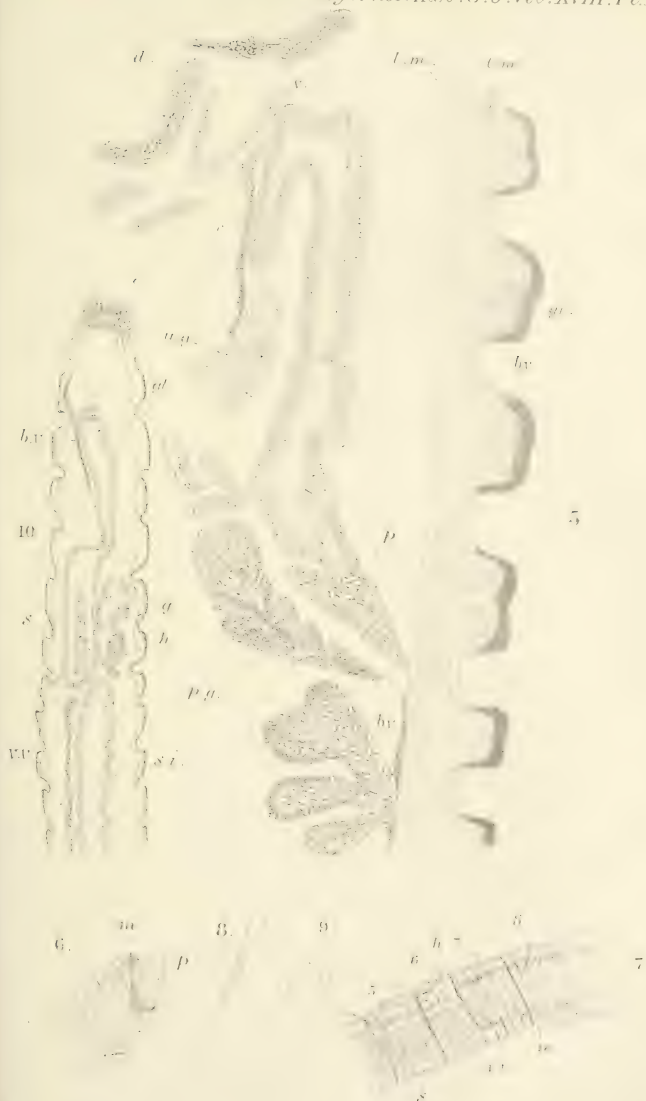
Wings slightly dusky.











(13) *Halictus pseudopectoralis*, sp. n.

♀. Length 7 millim. Black, shining; wings greyish. This so closely resembles the U.S. species allied to *pectoralis* that it will be only separated by a comparative description. The front above level of antennæ is closely punctured, as in the allied species. From *pectoralis*, Sm. (Illinois specimen, determined by Robertson), it differs by the darker wings, the somewhat broader face, the much less closely punctured mesothorax, the entirely black tegulæ, the more regularly wrinkled enclosure of metathorax, and the very distinct white hair-patches at lateral bases of segments 2 and 3 of abdomen. From *quadrifasciatus*, Rob., it differs by the somewhat darker wings, the larger head, the more sparsely punctured mesothorax, the black tegulæ, and the more strongly wrinkled enclosure of metathorax. From *pectoraloides*, Ckll., it differs principally in the strong regular longitudinal wrinkles of the metathoracic enclosure, but also in the darker wings and the brownish pubescence on the hind tarsi.

In its metathorax it resembles most *pectoralis*, in the sculpture of the mesothorax *pectoraloides*. The median impressed line of the mesothorax is very distinct.

Paso de Telaya, March 30; San Rafael, March 8 and 9. On *Bidens* and another composite.

Mesilla, New Mexico, U.S.A.,
Aug. 10, 1896.

XLV.—*Papers from the Gatty Marine Laboratory, St. Andrews.*—On the *Nephridia, Reproductive Organs, and Post-larval Stages of Arenicola*. By H. M. KYLE, M.A., B.Sc., Berry Scholar in Natural Science, University of St. Andrews.

[Plates XIII.–XV.]

WHILE endeavouring to work out the development of *Arenicola* I was naturally led to examine the nephridia and then the reproductive organs. Both of these have been described quite recently, by Cunningham in 1888 (4) and by Benham in 1891 (1), and in this paper I cannot do more than confirm their descriptions for the most part and add one or two points of interest.

On the sands of St. Andrews Bay and all round the coast *Arenicola* is got in great abundance and in all stages—from

the young transparent forms 3 to 4 inches in length to the older and larger of 14 inches and over. It is curious to notice how the external appearance of these larger forms varies according to the surroundings in which they live. From the clean bright gritty sand a form is got of a fine golden colour, with a smooth and glossy exterior, and exuding from its surface a gelatinous substance which is quite clear and transparent; from the muddy clay-flats another form is procured which has a rough and coarse appearance, is of a dark dirty brown colour, and gives off from its skin a green slimy gelatinous material.

From both of these forms the reproductive products may be obtained, and these may either be sperm-bundles or ova. The time of the appearance of these products is variously given by different writers, and, judging from my own observations, the animals seem to spawn during a period extending from January to September, though there is a cessation during April, May, and the first part of June. Temperature does not seem to be a determining influence, because in the height of midsummer (in July) specimens with ova were obtained at high-water mark, whilst in September similar specimens were found at low-water mark.

If the nephridium be dissected out from the side of the body and mounted, then the drawing of it given by Benham will be seen to be perfectly accurate. But this dissection implies the cutting of certain tissues around—the separation of the nephridium from the vascular system, the reproductive organs, and the oblique muscles. In the process of mounting also the nephridium is straightened out and its original form thus altered. For these reasons it seemed to me right to give still another drawing of the complete nephridium as seen *in situ*. Several other drawings of the complete nephridium have been given. Cosmovici's paper (3) came into my hands after my own had been completed, and my drawings agree with his more than with those of others. Cunningham's drawing, as well as his paper (4), is far too vague and indefinite to give one a proper idea of a nephridium. The drawing given by Vogt and Yung (6) agrees very closely with that of Cosmovici's, but the fringes on the dorsal lip of the nephrostome are not represented.

The fringes round the dorsal lip of the nephrostome are vascular processes connected with the branchial vessel. Benham describes these processes as if they were restricted to the lip of the nephrostome. In reality they are continued for a short distance behind the nephrostome over the neck; this can be seen both in transverse and longitudinal sections,

and Cosmovici's drawing shows it very well. They extend obliquely across the neck and end just above the posterior dilated part of the nephridium. From these blood-vessels pass into the tissue of the nephridium in all directions and posteriorly into the upper part of the gonad, which lies at the lower end of the neck.

The thin strips of muscles which stretch across the nephridium and bind it down to the side of the body have a slight attachment to these processes, but not to the nephridium; hence the neck of the nephridium can be moved about, and may be found lying parallel to the longitudinal axis of the body (Pl. XIII. fig. 1), or bent outwards so that it is almost at right angles to this axis, the nephrostome being then in a transverse plane (fig. 2). This movement is in all probability executed by means of the transverse strips of muscle through the connexion mentioned above.

The particular structure of the nephridium need not be more than mentioned, as Benham has fully described it, and the sections agree with his descriptions. The posterior dilated part, however, seems to be wholly glandular, without any muscular fibres. Such fibres appear as the dilated portion narrows between the longitudinal strands of muscle along the body-wall. To these strands the nephridium is in no way attached, and such points to the conclusion that the nephridium and the circular muscles are developed sooner than the longitudinal ones; and this finds further confirmation in that the nephridia and circular muscles, as Benham mentions, are present in the post-larval stages, whilst the longitudinal are hardly, if at all, evident.

Where the nephridium becomes connected with the transverse muscles muscular fibres are plentiful in its walls.

The canal to the exterior runs for a short distance round the body within the circular muscle-band, so that the external opening is controlled both by the muscles of the body-wall and by the muscular fibres of the nephridial wall. These latter are in reality but continuations of the circular fibres of the body-wall.

The nephridium of those with ripe products differs slightly from the normal, being more elongated and the walls thinner and more attenuated.

The reproductive organs (Pl. XV. fig. 5) can be found without much difficulty by means of sections of the nephridia—the second, third, and fourth pairs especially—of those animals which contain the genital products. Cunningham narrates that “loose cellular masses were often seen in the neighbourhood of the nephridia,” and that “these were traced to the cord of

cellular tissue attached to the nephridium." This is correct, but longitudinal sections through the nephridia with the part of the body-wall to which they are attached show more. These cellular masses are then obtained in position, and their relation to the parts around made out. The drawing of a transverse section by Benham gives a good idea of their position and shows, moreover, that the cord of cellular tissue of which Cunningham speaks runs down from the ventral lip of the nephrostome and sustains the upper portion of the gonad, while from the dorsal lip at its posterior end a blood-vessel runs to the same place. But this is not the only portion of the gonad. Springing from the epithelium lining the body-wall other cellular masses may be seen, and it is to these, I think, that Cunningham refers, being larger and more obvious than the upper portion in direct connexion with the neck of the nephridium. These masses lie immediately below the posterior dilated portion of the nephridium, and seem to have no connexion either with each other or with the upper portion of the gonad. They seem to have arisen by simple infoldings of epithelium into the body-cavity, and present the appearance of a palmate leaf, the veins being represented by a tissue composed of elongated cells, whilst round the edges is the tissue giving rise to the ova or sperm-mother-cells. At the base of the gonad is a blood-vessel; this is a prolongation of the branchial artery, and runs up from these masses through the upper portion of the gonad to the posterior extremity of the vascular processes on the dorsal lip of the nephrostome. Hence this blood-vessel connects the different portions of the gonad with one another.

Small worms answering to the descriptions given by Benham (2) and by Ehlers (5) of the post-larval stages of *Arenicola* are obtained here in the deep-sea tow-nets during the spring. Although got later than those mentioned by Benham, they are really younger, the largest specimen being 5 millim. in length. They are most frequently obtained in April and May, but in the middle of June 1895 a single specimen, of length 3.5 millim., was procured. This shows that the spawning-period must be spread over several months.

The gelatinous tube which envelops the animal is of a strong yet flexible nature. The movements are executed by means of wriggling the tail from side to side like an eel, and the tube bends with every movement. The little worm is thus able to swim easily through the water.

The attempt to cut longitudinal sections of specimens having the investing tube was a failure, owing to the firmness

and elasticity of the tube, whilst those that were free were readily cut.

The animals were examined in the living state, and some interesting points noted. In none of them was there any sign of gills; otherwise they agreed with the description given by Benham. There were two kinds of ventral chaetae (Pl. XV. fig. 9), however—one with a single prong like that of the adult, but more curved, the other with two.

The vascular system was easily traced through the transparent body-wall, and was of a distinct red colour. The heart expanded and contracted regularly, the time between two complete expansions being 4·3 seconds. The digestive glands lying close beside the heart were doing the same, but not so regularly, and taking a much longer time—11 to 16 seconds. Of the blood-vessels the most distinct was the ventral, whilst there were two little red swellings ventrally—one near the mouth, the other about the fourth somite.

The nephridia appeared as simple elongated tubes.

In the head-region (Pl. XIV. figs. 11–13) there is very little sign of the pit on the dorsal surface of the prostomium which is present in the adult. In section a slight depression is noticed behind the position of the brain on the dorsal surface, and this may be a sign of the beginning of the formation of the pit.

The pharynx is muscular and the body-cavity round it is filled up by loose mesenchyme-cells, which are not compact enough to form a definite tissue, but nevertheless seem to be contractile. The pharynx seems to be eversible, as in the adult, because in the specimen from which the sectional drawing (Pl. XIV. fig. 12) was made the pharynx was folded back towards the mouth. The epidermal cells of the prostomium are elongated, cylindrical in form, with yellowish contents of a granular nature. All the epidermal cells covering the first two somites contain this granular matter.

Within the prostomium the mesenchyme-cells surround ventrally a large space, dorsally the supræesophageal ganglion or brain. This brain, which has the appearance of "punct-substance," occupies a large portion of the interior of the prostomium. Dorsally it seems to be covered only by the mesenchyme-cells, and it looks as if the whole of this part were turned in to form the pit of the adult. Anteriorly nerve-filaments pass from the brain to end in the epidermal cells of the prostomium. Posteriorly in the median dorsal line scattered nerve-filaments pass backward, whilst at the sides filaments stretch to the otocysts and the commissures connecting the brain with the subesophageal ganglia. Ventrally

the brain is continued into one or two small protuberances, which project into the space lying above the mouth.

At the sides of the head immediately under the epidermal cells lie the otocysts, two in number. Each consists of a central cavity containing small, irregular, transparent bodies—the otoliths. There is a single layer of cells surrounding this cavity with very small cilia. This layer of cells, though quite distinct, is not so clearly marked off from the neighbouring tissue as in the adult, nor is it so compact or regular. In the adult the otocyst lies within the muscles of the skin and quite free from them; in this case it is close to the epidermis and is surrounded by the mesenchyme-cells. This mesenchyme-tissue is continued along the body-wall, and makes it difficult to distinguish between the longitudinal and circular muscles. The external layer of glandular cells is more highly pronounced than either of these muscle-layers.

The stomach—a long tubular organ—is lined by a single layer of cells, which are smaller than those of the gullet and other parts of the alimentary tract, and do not stain so deeply. The walls of the gut diverticula, which lie dorsally to the stomach, have small glands upon them which project into the lumen. These glands have a central vascular core with cells clustered round. The first part of the intestine consists of large cells, which are also glandular in their nature.

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EXPLANATION OF PLATES XIII.-XV.

Figs. 1 & 2. Nephridia in position :

- (1) where nephrostome is parallel to the long axis of the body ;
- (2) where nephrostome is inclined to this long axis.

a, fringed dorsal lip of nephrostome, the arrow points towards internal opening of nephridium ; *b*, thin, almost transparent part of the neck of nephridium ; *c*, dilated posterior portion, which contains amoeboid cells similar to those found in body-cavity, also a brown granular substance which seems to be the product of excretion from the cells in the central part of nephridium ;

d, main portion of nephridium, of a brown colour, due to granular matter in cells; *o.m.*, oblique muscles which bind down nephridium; *l.m.*, longitudinal muscles; *s*, notopodial bristle-sac; *n*, nerve-cord.

Fig. 3. Transverse section through nephrostome. *d*, vascular processes on dorsal lip, with excretory products between; *v*, ventral lip of nephrostome.

Fig. 4. Longitudinal section through nephrostome. *d* and *v* as above; *b.v.*, small blood-vessels which ramify over main portion of nephridium; *l.m.*, longitudinal muscles in body-wall.

Fig. 5. Longitudinal section to show reproductive organs. *d* and *v* as above; *c*, cord of cellular tissue running down from ventral lip of nephrostome to the upper part of gonad (*u.g.*), through which runs the blood-vessel (*b*); *p*, posterior dilated portion of nephridium; *p.g.*, posterior portions of gonad; *b.v.*, blood-vessels; *l.m.*, longitudinal muscles of body-wall; *t.m.*, transverse muscles; *gl.*, glandular layer of cells on external surface of body (hypoderm?).

Figs. 6-9. Drawings from live specimens of post-larval stages of *Arenicola*.

6. Anterior region. *m*, mouth; *p*, prostomium.

7. Four somites of body—fifth, sixth, seventh, and eighth. *h*, heart; *v.v.*, ventral blood-vessel; *g*, gut diverticula; *s*, stomach; *n*, nephridium.

8. Dorsal bristles.

9. Ventral bristles, of two kinds.

Fig. 10. Longitudinal section through portion of body. *o*, otocyst; *gl*, gullet; *g*, gut diverticula; *s.i.*, sacculated part of intestine; *h*, heart; *s*, stomach; *v.v.*, ventral blood-vessel.

Figs. 11-13. Sections through head-region. *s.æ.*, supra-oesophageal ganglion or brain; *o*, otocyst; *m*, mesenchyme-tissue; *c*, nerve-commissure from *s.æ.* to *sb.æ.*; *sb.æ.*, suboesophageal ganglion; *ph.*, pharynx.

11. Transverse section.

12 & 13. Longitudinal sections.

Fig. 14. Adult otocyst drawn for comparison with above.

XLVI.—On new small Mammals from the Neotropical Region.

By OLDFIELD THOMAS.

DURING the past six months several collections of small mammals from different parts of Central and South America have been received at the British Museum, and among these there are a certain number of new species, which may be conveniently all described in one paper.

GLYPHONYCTERIS *, gen. nov.

(Fam. *Phyllostomatidæ*; group *Vampyri*.)

Nose-leaf narrow, bound down to the muzzle in front. Chin-warts apparently only two, one on each side of a central

* γλύφειν, to chisel.

groove. Ears separate, not connected across the head. Tail short, perforating the interfemoral membrane and appearing on its upper surface. Wing-membrane from the side of the ankle.

Skull thin and papery. Profile-line from top of muzzle to crown nearly straight, not markedly concave. Anteorbital region broad, with a distinct inflation just above the anterior corner of each orbit, the breadth of the muzzle over the anteorbital foramina much greater than the postorbital breadth.

Dentition.—I. $\frac{2}{2}$, C. $\frac{1}{1}$, P. $\frac{2}{2}$, M. $\frac{3}{3} \times 2 = 34$.

Upper middle incisors large, vertical, chisel-shaped, their cutting-blades broad, very thin antero-posteriorly. Outer incisors minute. Canines short, sharply pointed, their antero-posterior basal about equal to their vertical diameter. Premolars subequal, oval or rounded in section. Lower incisors distinctly tricuspid, subequal. Canines low, scarcely exceeding the other teeth in height. Premolars subequal, the median one fully as large as the other two.

This genus is evidently most nearly allied to *Micronycteris* (*Schizostoma* of Dobson's Catalogue), but differs by its unconnected ears, broader muzzle, inflated anteorbital region, straight frontal profile, and peculiar chisel-shaped incisors. No other described genus shows its short tail, dental formula, and well-developed middle lower premolar.

Glyphonycteris sylvestris, sp. n.

Externally very similar to *Hemiderma brevicanda*, though rather smaller*. Ears short, their tip forming an almost square angle, the outer and inner edges distally being approximately at right angles to each other; lower part of outer edge ending in a low rounded lobule. Fur soft and fine, not extending on to the wings or limbs, except that the pollical metacarpals and the backs of the feet are thinly tufted. Colour above mixed smoky grey, the hairs dark smoky basally and terminally, white for their middle third; below they are smoky basally and dull whitish terminally. Interfemoral membrane broad, extending in the middle line to the level of the distal third of the tibiae.

Skull and teeth as described above.

* This resemblance is so great that almost the only character which affords a ready means of distinguishing the two is the short and delicate thumb of *Glyphonycteris* as opposed to the long heavily clawed one of *Hemiderma*. In colour the two are almost identical.

Dimensions of the type (an adult male skin) :—

Forearm 40 millim. (=1·56 inch).

Head and body (measured by collector in flesh) 50 millim.; ear (dried) 17; thumb, with claw, 9·2; middle finger—metacarpus 36, first phalanx 13·5, second phalanx 20, third phalanx 10·5; tibia 15; hind foot, with claws, 10·6; calcar 7·2.

Skull: greatest length 19·6; basal length 16; greatest breadth 9·6; breadth of muzzle at inflations, just over ante-orbital foramina, 5·7; interorbital breadth 4·6; front of upper canine to back of $\frac{m.3}{8}$.

Hab. Imravalles, Costa Rica.

Coll. C. F. Underwood, Nov. 8, 1895.

Rhipidomys venezuelæ, sp. n.

Closely allied to *Rh. macrurus*, Gerv., with which it shares the general rich rufous colour, long tail, and sharply defined pure white belly. Ears large, much larger and, especially, broader than in *Rh. macrurus*. General colour above rather orange-rufous in the type (an old male), but in a younger female clearer rufous, similar to some specimens of *Rh. Sumichrasti*. Hands and feet, as usual, with the metapodials brown mesially, the remainder and the digits white. Tail long, uniformly dark brown above and below, hairy and tufted, but less so than in most of the larger species of the group.

Skull with fairly long nasals; a rather narrow interorbital region, whose edges are sharply ridged. Interparietal large, its anterior edge very concave forwards. Anterior palatine foramina extending backwards to the level of the front edge of $\frac{m.1}{1}$.

Dimensions of the type (an adult male, measured in the flesh by collector) :—

Head and body 155 millim.; tail 160; ear 20. In the dried state the hind feet are 28 millim. long and the ear has shrunk to 19 millim.

Skull: basal length 31·2; basilar length from henselion 29; greatest breadth 19·5; nasals 12×4 ; interorbital breadth 5·2; interparietal $5·1 \times 9·2$; palate length from henselion 15·1; diastema 10; anterior palatine foramina $7·6 \times 3$; length of upper molar series 5·1.

Hab. Merida, Venezuela, alt. 1630 metres.

Coll. S. Briceno, March 5, 1896.

Besides the differences in the size of the ears and the hairiness of the tail this species differs from *Rh. macrurus* by

its decidedly narrower interorbital region and slenderer muzzle, the same cranial characters also separating it from *Rh. latimanus*.

Rhipidomys microtis, sp. n.

A rather small *Rhipidomys*, with a scarcely pencilled tail and very small ears.

Fur close and soft. General colour fulvous, duller and less rufous than in the majority of this group; perhaps nearest to Ridgway's "clay-colour"; in the centre of the back finely lined with black, clearer on the sides. Under surface white, the hairs white to the roots; line of demarcation on sides of belly less well defined than usual. Whiskers long and numerous. Ears small and narrow, thinly haired, pale brown. Metapodials brownish, digits dull white, but the difference little marked. Tail long, very finely scaled, uniformly brown throughout; scarcely more bushy than in non-*Rhipidomyine* Vesper-rats.

Skull of only specimen unfortunately much broken. Muzzle short and narrow, supraorbital ridges sharp. Zygomatic plate not projected forwards. Anterior palatal foramina long, reaching backwards to the level of the first lamina of m_1 . Molars as usual in the group.

Dimensions of the type (an adult male in skin):—

Head and body 109 millim.; tail 136; hind foot 25; ear 12 × 9.

Skull: basilar length from henselion (c.) 22; nasals 9·6 × 3·4; interorbital breadth 4·8; palate length from henselion 11·5; diastema 7·3; anterior palatine foramina 6 × 2·6; length of upper molar series 4·7.

Hab. Salina del Vatan, Western Cundinamarca, Colombia.

Type killed Nov. 16, 1895.

Rhipidomys fulviventer, sp. n.

About the size of *Rh. microtis*. Fur very thick and soft. General colour above fulvous, thickly lined with black. Underside clearer fulvous or even buff, the line of demarcation scarcely marked; hairs of belly slaty grey basally, buffy terminally. Chin and chest whiter. Mammæ 1—2=6. Ears rather small, uniformly brown. Metapodials with the usual piebald patches strongly marked; digits pure white. Tail long, uniformly brown, not very thickly haired basally, but with a long and well-defined pencil terminally.

Skull with a large rounded brain-case and slender narrow

face. Interorbital region flat, its edges square, not heavily ridged. Palatal foramina rather narrow for the group, extending backward to the level of the front of \underline{m}^1 . Bullæ rather, though not measurably, larger than in the allied species of the group.

Dimensions of the type (an adult female in skin):—

Head and body 113 millim.; tail 125, with terminal tuft 141; hind foot (moistened) 24; ear (dry) 14.

Skull: basal length 25·7; basilar length from henselion 23·8; greatest breadth 16·6; nasals $10\cdot5 \times 3\cdot7$; interorbital breadth 4·3, interparietal $4\cdot1 \times 10\cdot6$; palate length from henselion 12·8; diastema 8; palatine foramina $6\cdot2 \times 2\cdot2$; length of upper molar series 4·7. Lower jaw: condyle to incisor-tip 18·8.

Hab. Agua Dulce, W. Cundinamarca, Colombia.

Type collected Sept. 19, 1895.

This pretty Vesper-rat differs from all other members of *Rhipidomys* by its slate-mixed fulvous belly, this part being in the other species perfectly pure white. A very young specimen from Fanabistá corresponds in all respects with the old one.

Oryzomys niveipes, sp. n.

General appearance remarkably like *O. laniger*, Thos., although it is slightly larger. Fur very long, soft, and fluffy. General colour dull olive-fulvous, darker mesially above, clearer and paler along the sides and below; line of demarcation on sides indistinct. Hairs everywhere above and below slate-coloured basally. Ears large, well-haired, black. Hands and feet silvery white above, without darker metatarsals. Tail long, thinly haired, brown above, paler below.

Skull very different from that of *O. laniger*. Face long and slender, with a narrow muzzle and long, narrow, parallel-sided interorbital region, whose edges are rounded and not ridged. Brain-case smoothly rounded, not broad in proportion to its length. Zygomatic plate little projected forward. Palatal foramina reaching just past the anterior end of \underline{m}^1 .

Dimensions of the type (an adult male in skin):—

Head and body 113 millim.; tail 140; hind foot 26; ear 18.

Skull: basal length 26·8; basilar length from henselion 25; greatest breadth 16; nasals $12\cdot4 \times 3\cdot8$; interorbital breadth 4, interparietal $3\cdot5 \times 10\cdot5$; palate length from henselion 13·2; diastema 8·7; palatal foramina $7 \times 2\cdot4$; length of upper molar series 5. Lower jaw: condyle to incisor-tip 19·5.

Hab. La Oya del Barro, W. Cundinamarca, Colombia.

Type collected Sept. 2, 1895.

The resemblance of this species externally to *O. laniger* is so great that practically the only means of distinguishing the two lies in the brownish feet or, rather, metatarsals of *O. laniger* as compared with the silvery-white ones of the new form. The skulls, however, are wholly different from one another both in size and proportions.

Oryzomys (?) *lugens*, sp. n.

Very similar in all respects to the peculiar *O. incanus* described recently from Peru *. Fur soft, close, and velvety. General colour finely grizzled olive-brown, but little lighter below than above. Ears large, brown. Hands and feet slender, thinly haired, brown above, the hairs at the bases of the claws whitish. Tail about the length of the head and body, uniformly thinly haired, brown above, rather lighter below.

Skull in shape almost suggesting that of an *Oxymycterus* or *Acodon*. Muzzle long, cylindrical. Interorbital convex above and rounded laterally, without trace of ridges; indeed, a section through the nasal chamber between the orbits would present an almost circular outline. Brain-case narrow, smoothly rounded. Zygomata very slender, little expanded, their anterior root narrow, slanted, without projecting plate. Palatine foramina extending back to the level of the front of $\overline{m.1}$. Lower jaw very slender, matching that of *O. incanus*. Molars rather Acodont in appearance, with comparatively high crowns; $\overline{m.1}$ with its anterior lamina unicuspid, so as to present only five cusps in all.

Measurements of the type (an adult female in skin):—

Head and body 114 millim.; tail 118; hind foot 27; ear 17.

Skull: basal length 26; basilar length from henselion 24; greatest breadth 14·8; nasals 12·2 × 3·8; interorbital breadth 6; breadth of brain-case 12·8; anterior zygoma-root 2·1; length of palate from henselion 13·2; diastema 8·3; palatine foramina 5·9 × 2·6; length of upper molar series 4·8. Lower jaw: condyle to incisor-tip 19·7.

Hab. La Loma del Morro, near Merida, Venezuela, alt. 3000 metres.

Coll. S. Briceno, May 18, 1896.

"Eyes black, excessively small. Makes its nest in trees."
—S. Briceno.

* Ann. & Mag. Nat. Hist. (6) xiv. p. 350 (1894).

As in the case of "*Oryzomys*" *incanus*, it is impossible to assign a satisfactory position to this species, which differs in nearly every respect from typical members of the genus; but without a far more extensive knowledge of South-American Murines than is possessed at present, it would be unwise to add to the number of named groups of what used to be called "*Hesperomys*." Without doing this, however, I frankly confess myself incapable of finding a proper place for the present animal, and merely put it nominally under the heading of *Oryzomys* as a temporary expedient. Its slender form and long tail separate it from *Acodon*, its nail-clad pollex and normal muzzle show that it is not an *Oxymycterus*, while its narrow brain-case and rounded interorbital region separate it from all the ordinary species of *Oryzomys*.

As a species *O. lugens* seems really most closely allied to *O. incanus*, from which it differs by its much narrower brain-case, more rounded interorbital region, and differently shaped zygomatic root. Externally it seems very similar, but as the type of one is in spirit and the other in skin, an accurate comparison of the quality and colour of the fur is not at present possible.

*Eligmodon** *Moreni*, sp. n.

Size rather large as compared with the very small species composing the group. Fur long and soft, but not woolly. General colour above coarsely mixed fawn and brown, clearer fawn on the sides. Belly, as usual, pure white or yellowish white. (Immature specimens have the bases of the belly-hairs slate.) Ears large, oval. Palate-ridges 3—5. Upper sides of hands and feet silvery white. Palms and soles as usual in the group, granulated, with a large more or less hairy and corrugated pad at the base of the fingers and toes; a smaller more defined pad at the bases of pollex and hallux, and another a little way behind the last-named. Tail longer than the head and body, slender, thinly hairy throughout, blackish above, white below and on the sides.

Skull stoutly built, with a broad muzzle. Interorbital region flat, its edges square, not beaded. Anterior palatal foramina reaching backward one third the length of $\frac{m.1}{m.2}$. Posterior nares very narrow.

Dimensions of the type (an adult male in spirit):—

Head and body 80 millim.; tail 91; hind foot 23; ear 17.

* *Calomys*, Waterh. (1837) nec Is. Geoff. (1830).

Eligmodontia, F. Cuv. 1837.

Hesperomys, Waterh. 1839.

Skull: basal length 20·5; basilar length 18·8; greatest breadth 12·4; nasals $10 \times 2·9$; interorbital breadth 4; interparietal $3·2 \times 9·7$; palate length from henselion 11; diastema 6·5; anterior palatal foramina $5·4 \times 1·6$; length of upper molar series 3·6. Lower jaw: condyle to incisor-tip 15·1.

Hab. Chilecito, Prov. Rioja, Argentina, alt. 1200 metres.

Collected and presented by Dr. F. P. Moreno, the distinguished head of the La Plata Museum, in whose honour I have named this very pretty little mouse.

Eligmodon Moreni is most nearly allied to *E. elegans*, Waterh. (*E. typus*, F. Cuv.), but is distinguished by its greater size, longer feet, and heavier muzzle. The type of Waterhouse's species being a bleached and deteriorated skin, and all the examples of the new form being in spirit, it is impossible to compare them very satisfactorily; but when further specimens are available there is little doubt that, judging by the great distance between the localities, other differences will become appreciable.

Oxymycterus Iheringi, sp. n.

Much smaller, more slenderly built, and less *Oxymycterine* than *O. nasutus*, *rufus*, and the other more typical species. Fur soft and thick. General colour uniform grizzled brown, scarcely paler below. Eyes not unusually small. Ears fairly large, thinly haired, brown. Claws much less lengthened than in *O. nasutus*, but still with the essential fossorial structure characteristic of the group; pollical claw short. Fifth hind toe decidedly longer than the hallux, reaching to the level of the base of the fourth toe. Tail almost as long as the head and body, slender, thinly haired, brown above, rather paler below. Mammæ 1—2=6.

Skull not specially elongated anteriorly, although the muzzle shows something of the characteristic *Oxymycterus* structure. Supraorbital edges smoothly rounded. Interparietal and anterior zygoma-root and other details very much as in *O. nasutus*, in spite of the great difference between the two in the general proportions of the skull.

Dimensions of the type (an adult female in spirit):—

Head and body 100 millim.; tail 94; hind foot 23·5; ear 16·7.

Skull: basal length 23; basilar length from henselion 21·4; greatest breadth 13; nasals $11 \times 3·8$; interorbital breadth 6; breadth of brain-case above meatus 12·5, interparietal $2·2 \times 7·3$; palate length from henselion 10·7; diastema 6·8; anterior palatine foramina $5·2 \times 2·2$; length of

upper molar series 4.2. Lower jaw: condyle to incisor-tip 16.8.

Hab. Taquara, Rio Grande do Sul.

Coll. Dr. H. von Ihering.

Type B:M. 86. 9. 16. 8.

The two specimens of this species in the Museum are part of the large collection of Taquara rodents worked out by Dr. Leche*, by whom the present animals were called *Oxy-mycterus nasutus*, under which name they have remained in the Museum collection until now. Among other rodents collected by Dr. von Ihering at San Lorenzo, in the same province, there are specimens undoubtedly referable to the true *O. nasutus*; but these two from Taquara, and no doubt the others seen by Dr. Leche, are so different that there can be no question as to their specific distinction†. Dr. Leche was no doubt led astray by Hensel, in whose classical paper on the mammals of Rio Grande do Sul‡ the species now described is also referred to *O. nasutus*. Hensel's account must therefore in future be assigned to *O. Iheringi*, to our knowledge of whose structure and habits he makes some valuable contributions. The difference between the two forms is so great that it is difficult at first sight to realize that *O. Iheringi* is an *Oxy-mycterus* at all, as it is quite without the extraordinary trumpet-shaped muzzle possessed by *O. nasutus* and its allies. Probably it is most nearly related to Winge's *O. talpinus*§, as yet only known fossil from Lagoa Santa, but has rather a shorter head and shorter palatine foramina; so that I have not been able to assign it to the fossil form, as in the case of the animal next to be described.

In many ways *O. Iheringi* leads up towards *Blarinomys* (described below), but as it possesses an interparietal, it may fairly be called an *Oxy-mycterus* for the present, in spite of its not possessing the characteristic snout of ordinary *Oxy-mycterus*.

I have ventured to name this interesting species in honour of Dr. H. von Ihering, now Director of the São Paulo Museum, who obtained the specimens described, and to whose exertions, both as collector and writer, we are indebted for much of our knowledge of the fauna of Rio Grande do Sul.

* Zool. Jahrb. i. p. 700 (1886).

† Dr. Leche says that of nineteen skulls examined by him the largest had a basilar length of 22 millim. The basilar length of the true *O. nasutus* is from 27 to 29 millim.

‡ Abh. Ak. Berl. 1872, p. 43.

§ E Museo Lundii, iii. p. 36 (1887).

BLARINOMYS *, gen. nov.

Most nearly allied to *Oxymycterus*. Form talpine or soricine, modified for burrowing. Head short, conical. Eyes quite minute. Ears small. Claws long, as in *Oxymycterus*; a distinct claw on the pollex; feet proportionally broad. Tail short. Fur crisp, velvety, iridescent.

Skull with most of the characters of that of *Oxymycterus*, but much shortened in the face and broadened posteriorly, so that the zygomatic barely exceeds the posterior cranial breadth. Interparietal entirely absent. Structure of molars as in the allied genus.

Type "*Oxymycterus*" *breviceps*, Winge †.

The peculiarities of *O. breviceps*, now for the first time properly known, render its retention in the genus *Oxymycterus* impossible. No doubt it is most nearly allied to that genus, but its blunt conical head, minute eyes, stiff iridescent fur, and absent interparietal are characters of such importance as to demand its generic separation.

The species was founded by Winge on the muzzle of a skull found fossil in the bone-caves of Lagoa Santa, and has not hitherto been known in the recent condition. The following description of the animal may therefore be of service. The specimen described is an adult male preserved in spirit, and was obtained by the well-known naturalist Dr. Emil A. Goeldi at Colonia Alpina, Theresopolis, Rio Janeiro.

Size and form about as in the short-tailed field-vole (*Microtus agrestis*). Fur short, velvety, crisp, and almost semispinous, some of the hairs being broadened and flattened. Colour of fur all over above and below uniform dark slaty grey, the tips of the hairs brown; a marked iridescence, chiefly ruby colour, visible on the back, at least while the fur is wet. Tip of muzzle, chin, and eyelids without brown hairs, and therefore in spirit showing prominently white; probably flesh-coloured in life. Eyes minute, hidden in the fur, scarcely $1\frac{1}{2}$ millim. in their longest diameter. Ears very small, thickly furry, not projecting above the fur of the head. Palate-ridges 3—4. Hands and feet brown above; under-side of heel hairy, brown; pads 5 in front, 6 behind, the latter very small. Tail thinly hairy, uniformly brown.

Dimensions:—

Head and body 92 millim.; tail 46; hind foot 15·3; ear 9, flap of ear measured from behind 4·7.

* From *Blarina*, the genus of American short-tailed Shrews.

† E Museo Lundii, iii. p. 34 (1887).

Skull: basal length 21; basilar length 19·2; greatest zygomatic breadth 13·2; nasals $10·2 \times 3·8$; interorbital breadth 7·0; intertemporal breadth 6·2; breadth across brain-case above auditory meatus 13·1; palate length from henselion 10; diastema 5·8; palatal foramina $4·7 \times 2·4$; length of upper molar series 4·1. Lower jaw: condyle to incisor-tip 15·4.

This most interesting and peculiar little animal has a certain superficial resemblance to *Acodon nigrita*, Licht., found by Dr. Goeldi at the same time and place, but is readily distinguished by its many essential differences. It is evidently a regular burrower, and probably passes a more mole-like life than any other Sigmodont as yet described.

Ctenomys Perrensi, sp. n.

Size of and most nearly allied to *C. torquatus*, Licht. General colour dark buff or clay-colour, heavily mixed with black along the median line of the face and back. From eye to ear and below the latter a rather lighter patch, succeeded below again by the brownish cheeks. Under surface from throat to belly rich buff ("ochraceous-buff" of Ridgway), but patches on the axillæ and groins are pure sharply contrasting white. Upper surface of hands and feet thinly haired, white.

Skull short, broad, and rounded, not heavily ridged. Zygomatic decidedly exceeding the posterior breadth. Nasals short, tapering backwards, unusually little, broad and truncated behind. Interorbital region short and very broad, the postorbital processes and ledges little developed. Frontoparietal suture nearly directly transverse, little bowed backwards. Bullæ small and little inflated, especially anteriorly. Incisors more curved backwards terminally, and therefore forming a larger arc of a smaller circle than usual.

Dimensions of the type (an adult male, measured by collector):—

Head and body 200 millim.; tail 67; hind foot 31, with claw (dried) 37.

Skull: basal length 43·5; basilar length from henselion 40·7; zygomatic breadth 30; posterior breadth on bullæ 23; ditto on projecting lip of meatus 27·3; least breadth behind zygomata 19·3; nasals $16·2 \times 7·6$; interorbital breadth 11·5; length of frontals in middle line 13; palate length from henselion 21·3; diastema 12·9; tip of incisor to alveolus of \underline{p}_4 14·9. Lower jaw: back of condylar process to tip of incisors 35; greatest breadth 35·8.

Hab. Goya, Corrientes, Argentina.

Collected by Mr. Richard Perrens, May 7, 1896.

This species is readily distinguished from *C. torquatus*, the Uruguayan Tuco-tuco, which appears to be its nearest ally, by its very differently coloured under surface, less tapering nasals, and more backwardly curved incisors. In colour, especially below, it is very like Waterhouse's *C. boliviensis*, but is, of course, very far smaller.

I have named this species in honour of its discoverer, Mr. Richard Perrens, to whom we are indebted for the re-discovery of Azara's "Micouri à queue longue," of which I gave an account in 1894*.

C. Perrensi may prove to be Azara's Tuco-tuco; but that animal has never had a distinctive name applied to it, owing to its identification with the Minas Geraes form, *Ctenomys brasiliensis*, de Blainv.

Lower down the same river-system, at La Plata, another Tuco-tuco occurs, apparently referable to *C. minutus*, Nehring.

Echinomys centralis, sp. n.

Both in the Merida and Bogotá collections there occur specimens of the genus *Echinomys* which, on account of their (in comparison with other species) "very dark brown colour" and other characters, may fairly be assigned to *E. semispinosus*, Tomes†, especially if, as seems to be the case, Tomes's woodcut of the skull is incorrect in details.

But if these are *E. semispinosus*, two examples, clearly different, recently received from Nicaragua, cannot be that animal, and therefore need description as new.

No doubt they are the same as the examples of "*E. semispinosus*" recorded by Mr. True‡ from Greytown, Nicaragua, and from Pacuare, Costa Rica; so that further details about the species may be gained from his paper.

Size, as judged by the skull, about as in *E. semispinosus*. General colour much brighter and richer, less heavily black-lined on the back, and with the spineless fur of the sides and rump much brighter rufous. Hands and feet dull whitish above, the darker mark which runs along the outer §

* Ann. & Mag. Nat. Hist. (6) xiv. p. 184.

† P. Z. S. 1860, p. 265.

‡ P. U. S. Nat. Mus. 1888, p. 467.

§ Messrs. Allen and Chapman in their description (Bull. Am. Mus. N. H. v. p. 224, 1893) say "inner," but have evidently been misled by the reversed position of the feet in the skins examined. This is a little

side of the metatarsal in some species—notably in *E. trinitatis*, All. & Chap.—little marked.

Skull, as compared with those of the specimens assigned to *E. semispinosus*, distinguished by the following characters:—The nasals run evenly backwards to a sharp median point, instead of being more or less bluntly truncated behind. The ankylosed parieto-interparietal suture runs nearly squarely across, instead of being evenly convex forwards, and from its outer corners little ridges run forwards to meet those that run back from the supraorbital ledges, while in the allied species the posterior ridges are at a higher level and do not coalesce with the anterior. Zygomata much broader both in the ascending and horizontal portions. Anterior palatine foramina narrower and less widely open. Posterior nares more widely open. Pterygoid processes broad and spatulate, over 2 millim. in their greatest diameter, as compared with about 1 millim. in *E. semispinosus*.

Dimensions of the type (an adult male):—

Hind foot, without claw 49 millim., with claw 53*.

Skull: basal length (c.) 47·5; basilar length 41; greatest breadth 26·5; nasals 21·3 × 6; interorbital breadth 12·5; breadth of interparietal 12·5; palate length from hensenion 20; diastema 12·5; anterior palatine foramina 5 × 2·5; length of upper molar series 9·2. Lower jaw: back of condylar process to incisor-tip 34.

Hab. San Emilio, south end of Lake Nicaragua.

Coll. W. R. Richardson.

Type obtained March 27, 1896.

The above differences, slight as they seem, are perfectly constant through series of seven of the Colombian and two of the Nicaraguan form, and it is therefore evident that the two animals cannot be regarded as both belonging to *E. semispinosus*. *E. trinitatis*, again, though belonging to the same group, is evidently quite distinct from either of the others.

Marmosa fuscata, sp. n.

Size rather smaller than in *M. incana*, Lund †. Ears

trap which one has to be constantly on one's guard against in describing from modern skins. Another slip in the same account is that the molar series is said on p. 224 to be 10 millim. long and is given as 8·5 in all the specimens measured on p. 226. The latter is evidently correct.

* The skin is too badly made to make other external measurements worth taking; but Mr. True (*l. c.*) has given accurate measurements of several spirit-specimens of what is no doubt the same species.

† *Didelphys grisea* of Cat. Mus. B. M. p. 349, but not of Desmarest. For the real *M. grisea* an earlier name has since turned up in *Didelphys*

large, their internal basal projection small; a rounded lobe at the base of their outer edge. Fur close, soft, and velvety. General colour above a dark smoky or bistre-brown, a dull buffy tinge present on the fore back and sides. Under surface dirty whitish, the slaty bases of the hairs showing through; line of demarcation on sides fairly well defined. Colour of face, limbs, and tail as in *M. incana*.

Skull similar in its general proportions to that of *M. incana*, but decidedly smaller. Supraorbital edges not beaded. Anterior palatine foramina extending backwards only to the canines. Canines very short. Middle upper premolars longer horizontally than vertically, very narrow transversely.

Dimensions of the type (an adult female in skin, apparently somewhat contracted):—

Head and body 118 millim.; tail 138; ear 19.

Skull: lambda (back end of parietal suture) to nasal tip 29; greatest breadth (c.) 17; nasals 14×4 ; interorbital breadth 6; intertemporal breadth 6.1; palate length 18; palate breadth between outer corners of $\frac{m. 3}{m. 1-3}$ 9.6. Combined length of $\frac{m. 1-3}{m. 1-3}$ 5.5.

Hab. Rio Abbaregas, Merida, Venezuela, alt. 1630 metres.

Coll. S. Briceno, April 6, 1896.

The Merida collection contains three species of the *Marmosa* group, of which the largest is a typical *M. murina* and the smallest is so like *M. pusilla* that, in spite of the considerable extension of the known range involved, I do not see any reason for distinguishing it. The middle one, however, although it may be said to represent *M. incana*, cannot be actually assigned to that species, from which it differs by its decidedly smaller size and much darker colouring, notably that of the lower surface. No other described species is at all like it.

XLVII.—*Descriptions of new Terrestrial Mollusca from South Africa.* By JAMES COSMO MELVILL, M.A., F.L.S., and JOHN HENRY PONSONBY, F.Z.S.

[Plate XVI.]

SINCE the publication of our last paper (Ann. & Mag. Nat. Hist. ser. 6, vol. xvi. p. 478), describing five new *Ennean* from the South-African region, two more, both of them conspicuous

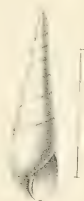
marmota, Oken, Lehrb. Nat. iii., Zool. ii. p. 1140 (1816), so that the Paraguay and Corrientes species must bear the name of *Marmosa marmota*. (See Ann. & Mag. Nat. Hist. (6) xiv. p. 184, 1894, and (6) xvi. p. 58, 1895.)



4.



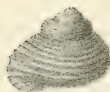
3.



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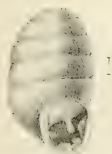
1.



8.



2.



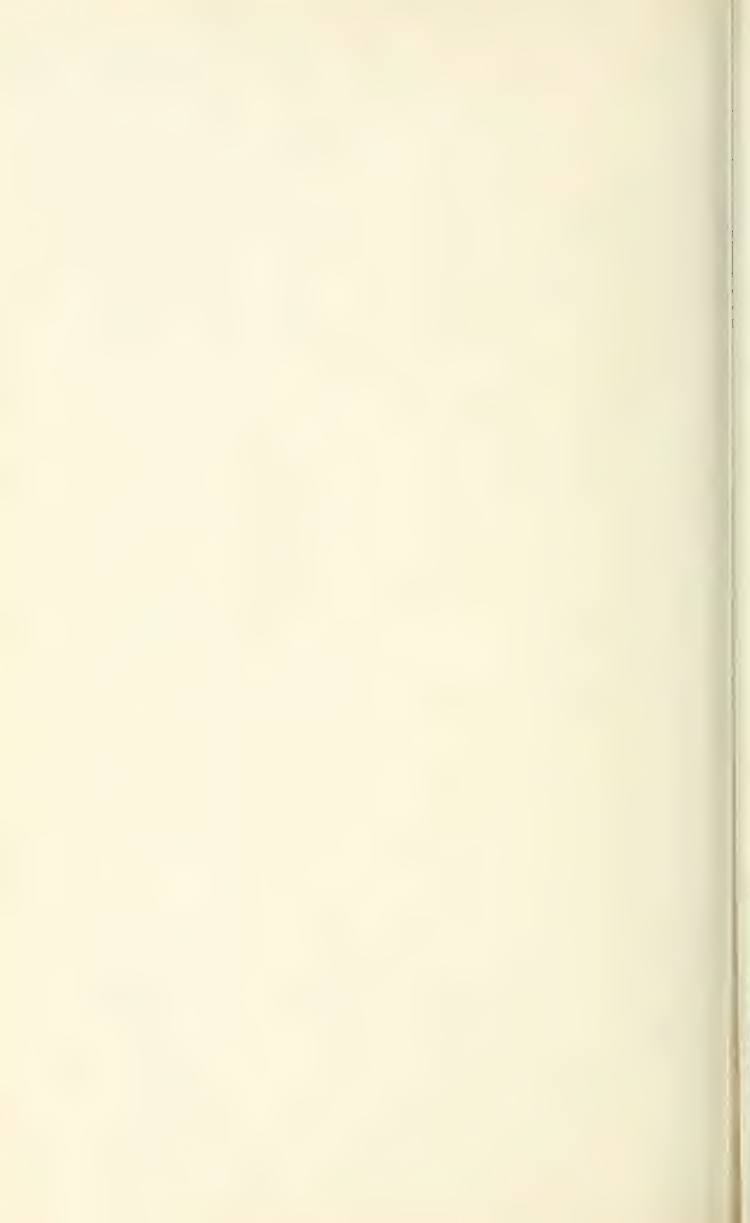
6.



9.



7.



species, have come under our notice. These are now described, together with a few less noteworthy but equally interesting *Subuline*. One of these, indeed, is a marvellous shell, and perhaps ought to be made the type of a new genus.

Ennea impervia, sp. n. (Pl. XVI. fig. 1.)

E. testa subrimata, dolioliformi, cinerea, crassiuscula, apice perobtusum; anfractibus 7-8, ventricosus, apud suturas impressis, undique longitudinaliter oblique crassicostulatis; apertura oblonga; peristomate albo-nitente, late incrassato, plicis vel dentibus plurimis arcuatis munito, plica parietali valde intrante, conspicua, plicis labialibus bi- vel trifurcatis, interne involutis, longeque penetrantibus; plica columellari trifurcata, interne perintrante, aperturamque ipsam ad faucem fere obcludente.

Long. 7.50, lat. 4.50 mm.

Hab. Natal.

Shell subperforate, tun-shaped, ashy in colour, slightly thickened; whorls seven or eight, ventricose, impressed at the sutures, and longitudinally uniformly obliquely ribbed. The aperture is oblong; lip shining white, thickened, fortified with several plaits and teeth, the parietal plait being deep-seated, large, and well developed, the labial multifarious, involute, and twice or thrice furcate, being likewise deep-seated; the columellar trifurcate, very deeply seated, and almost closing the aperture.

A very remarkable form, approaching *E. infrendens*, Gould.

Two specimens.

Ennea Queketti, sp. n. (Pl. XVI. fig. 2.)

E. testa obtuso-cylindrica, pellucida, subvitrea, apice obtuso; anfractibus octo, tenuibus, ventricosulis, ad suturas impressis, sub lente arete longitudinaliter undique striatis; apertura rotunda; peristomate albido, plicis dentibusve tribus instructo, plica parietali magna, acinaciformi, intrante; dente labiali parvo, superficiali; plica columellari inconspicua, perintrante.

Long. 13, lat. 6 mm.

Hab. Natal. Two specimens.

Shell large, white, vitreous, delicate, obtusely cylindrical; whorls eight, somewhat swollen, under a lens they are seen to be uniformly closely obliquely striate; the mouth is rounded, lip white, slightly expanded, furnished with three processes, viz. a deeply seated parietal plait, a small superficial labial tooth, and a deep-seated but inconspicuous columellar plait.

This large species most resembles *E. Planti*, Pfr., amongst Natalese *Enneæ*, but differs in possessing a tooth on the outer lip.

Subulina læocochlis, sp. n. (Pl. XVI. fig. 3.)

S. testa sinistrorsa, fusiformi, versus apicem attenuata, fere lævi; anfractibus tridecim, supra angustis, infra latioribus, minime ventricosis, undique longitudinaliter obscure obliquistriatis, anfractu ultimo antice apud medium subangulato; apertura oblonga: peristomate extus tenui, marginem ad columellarem recto, ad basin paullum producto, reflexo.

Long. $1\frac{3}{8}$, lat. $\frac{5}{16}$ unc.

Hab. Humansdorp, St. Francis Bay.

Shell sinistral, fusiform, the upper whorls somewhat attenuate; whorls thirteen in number, mostly very narrow, broadening distinctly towards the base. The specimens (two) before us being dead, we cannot tell the colour, but probably it is pale olivaceous. The whorls are nearly smooth, but are obscurely longitudinally obliquely striate, the basal whorl slightly angled in front; aperture oblong, the columellar margin being straightly produced and slightly reflexed.

An extraordinary species, unlike any member of the genus that we are acquainted with. Our specimens, though dead, and consequently imperfect, yet show very clearly all the peculiarities of its conformation.

The superficial resemblance to the Cerithioid (marine) *Læocochlis granosa*, S. Woodw., has suggested the trivial name. Although we have only seen two specimens, we understand many more were collected.

Pseudobalea dominicensis, Shuttleworth, is sinistral, but *S. læocochlis* does not belong to that subgenus. Should subsequent researches justify the erection of a separate genus or subgenus for this very remarkable sinistral form, based upon the characters as just given, we would suggest the name *Euonyma* * for its reception.

Subulina crystallina, sp. n. (Pl. XVI. fig. 4.)

S. testa pervitrea, gracillima, tenuissima, nitida, omnino lævi; anfractibus undecim, ad suturas impressis, rectis, sensim accrescentibus, ultimo paullum producto; apertura parva, ovata; peristomate tenui, simplici.

Long. 15, lat. 3 mm.

Hab. Pietermaritzburg.

* Gr. εὐώνυμος, lævus.

A very graceful glassy species, separable at a glance from its South-African congeners. The shell is quite smooth, eleven-whorled, the whorls impressed at the sutures and gradually increasing, last whorl a little produced; mouth small, ovate, lip thin.

Six specimens.

Subulina glaucocyanea, sp. n. (Pl. XVI. fig. 5.)

S. testa fusiformi, cornea, cærulescente, parum nitida; anfractibus 10-11, paullum planatis, obscure striatis, striis fere rectis; apertura ovato-oblonga; peristomate extus tenui, marginem apud columellarem reflexo, recto.

Long. 22 (sp. maj.), lat. 5 mm.

Hab. Port Elizabeth.

Allied, doubtless, closely to *S. turrimiformis*, Krauss, the commonest and best-known South-African species, but differing in the following particulars:—(a) greater size; (b) texture, being more transparently corneous; (c) colour, a livid glaucous blue; and (d) lastly in the whorls being less impressed at the sutures.

Many specimens, some of them young shells, all similar in colour, form, and texture.

Pupa amphodon, sp. n. (Pl. XVI. figs. 6, 7.)

P. testa minuta, superficialiter umbilicata, dolioliformi, brunnescente, apice obtuso: anfractibus septem, quorum duobus apicalibus, cæteris ventricosulis, longitudinaliter indistincte obliquistriatis, anfractu ultimo apud basin paullum producto; apertura lunata; peristomate rotundo, incrassato, reflexo, intus plicis vel dentibus 5 instructo; dente parietali magno, recto; labiali extenso, scaleno-triangulari, duobus basalibus, hoc bimamillato, illo, juxta columellam, obtuso, lato; dente columellari brevi, mamillato.

Long. 3, lat. 1.15 mm.

Hab. Zwartkops, near Port Elizabeth.

A small cylindrical species of the "*fontana*" group. In many ways it approaches *P. frustillum*, M. & P., but differs entirely in the labial tooth-processes. It is subrimate, with seven whorls, two of them being apical, the apex itself extremely obtuse; whorls slightly ventricose and indistinctly longitudinally striate; mouth lunar; peristome round, furnished with five processes, which well nigh close the orifice. The parietal tooth is the most conspicuous of these and is straight and produced, the labial is broadly triangular, the

two basal are respectively doubly mamillar and broadly triangular, and the remaining columellar tooth is smaller, rounded, and mamillar. The peristome is incrassate, reflexed, and broader towards the columellar region.

The specific name is the Greek ἀμφώδων, "encircled with teeth."

Cyclostoma ochraceum, sp. n. (Pl. XVI. figs. 8, 9.)

C. testa conico-depressa, anguste sed profundissime umbilicata, unicolore, brunneo-ochracea, parum solida; anfractibus 5, quasi tabulatis, duobus apicalibus lævibus, apice mamillato, cæteris spiraliter arcte filoliratis, liris acutis, regularibus, interstitiis sub lente obliquistriatis, ultimo rapide accrescente; apertura rotundata; peristomate continuo, simplici; operculum normale.

Long. 13.50, lat. 15 mm.

Hab. S. Africa.

Much larger than *C. transvaalense*, M. & P.; of different form, but of the same character so far as the spiral ridging is concerned. The shell is conically depressed; umbilicus narrow but very deep; apex mamillated, it and the first whorl are smooth, the others uniformly spirally ridged, the interstices being very finely obliquely striate. Colour a warm ochraceous brown, suggesting the specific name.

EXPLANATION OF PLATE XVI.

Fig. 1. Ennea impervia.

Fig. 2. Ennea Queketti.

Fig. 3. Subulina læocochlis.

Fig. 4. Subulina crystallina.

Fig. 5. Subulina glaucocyanea.

Figs. 6, 7. Pupa amphodon.

Figs. 8, 9. Cyclostoma ochraceum.

XLVIII.—Diagnoses of new Mammals from Madagascar.

By C. I. FORSYTH MAJOR.

LIMNOGALE, gen. nov.

(Fam. Centetidae.)

Head short, broad and flattened. Toes webbed. Tail powerful; very thick and almost square in the proximal half, the distal part laterally compressed. Skull broad and flattened. Cerebral region low; facial region comparatively high, but very short and broad. Zygomatic processes of

maxillary and squamosal present, but no zygomatic arches. No postorbital processes. Nasals *not* united. Tympanics ring-shaped. Infraorbital foramen large, bounded above by a very narrow, rod-like, bony arch. Frontals short and narrow, parietals broad and elongated. A minute interparietal. Foramen magnum very large. Clavicles present.

Dental formula.—I. $\frac{3}{3}$, C. $\frac{1}{1}$, P. $\frac{3}{3}$, M. $\frac{3}{3} \times 2 = 40$.

Premolars and molars presenting the general type of the Centetidæ family, and more especially of its smaller members with soft hairs. The inner pair of upper incisors caniniform and of considerable size, larger than the upper canines, their lower moieties divergent, so as to leave a triangular space between them, into which fit the two lower inner incisors, which are small and converging upwards towards each other. The second pair of lower incisors are likewise caniniform and larger than the canines. Second upper incisors almost of the size of the upper canines.

By the absence of zygomatic arches and postorbital processes, the ring-shaped tympanics, and by the form of the crowns of the molar teeth this new genus is shown to be a member of the Centetidæ; but it is as strikingly modified for aquatic life as *Potamogale* or *Myogale*.

1. *Limnogale mergulus*, sp. n.

General coloration of upper parts brownish, consisting of a mixture of fawn-coloured shorter hairs with less numerous and longer black ones, the posterior back blacker than the anterior. Upper surface of muzzle covered with short black-brown hairs. Whiskers of moderate size, not exceeding 30 millim. in length, nearly all pure white. Ears short, higher than broad; inner and outer sides of conchæ covered with short, dark grey hairs. Behind the ears a small patch of dark grey hairs. Lower parts of a light yellowish grey. The toes, both in manus and pes, united by a blackish membrane, wider in the pes and leaving the claws free. Outer margin of fifth toe of pes and corresponding metatarsal fringed with ciliate, thickly set, grey hairs; the same on manus, but longer and white-coloured. Likewise white, ciliate, but shorter hairs on the inner margins of pollex and hallux and the first metacarpal and metatarsal. Upper and lateral surface of tail scaly, thinly haired, dark brown; lower surface occupied by longer, thickly set, yellowish-white hairs.

Dimensions in the flesh of the Andraykiba specimen (♂):—

Head and body 128 millim.; tail 134; length of ear 9; fore foot (without claws) 16.5; hind foot (without claws) 30.

Skull of the type (♀): basal length 32; length of nasals in middle line 11·5; greatest breadth of skull across brain-case 16·5.

Type skin M. 1024 (♀). Caught March 18, 1896.

Hab. Imasindrary, N.E. Betsileo; another specimen (M. 805) was obtained in a marsh west of Andraykiba lake, two hours to the west of Sirabè (Vakinankaratra district, S.W. Imerina), at about 1600 metres above sea-level.

Local name *voalavorano* (*i. e.* water-rat).

2. *Microgale Thomasi*, sp. n.

Externally very like *M. Cowani*, but much larger. Colour of skin as in *M. Cowani* and *M. longicaudatus*, with a slightly lighter tinge. Ears large. Claws of manus longer and more curved than in *M. Dobsoni*, smaller than those of *O. gracilis*; curvature as in *M. Cowani*.

Type (M. 581) from Ampitambè forest (N.E. Betsileo), July 19, 1895; a second specimen (M. 202) from Ivohimanitra forest, in the country of the Tanala of Ambohimanga, Nov. 1894.

Measurements of type:—

Head and body 97 millim.; tail 64; manus 11; pes 19; length of ear $19\frac{1}{2}$; breadth of ear 14.

Length of skull 25·5; breadth across maxillary zygomatic processes 10·7; interorbital breadth 6.

Second specimen:—

Head and body 91; tail 62; manus 12; pes 19; length of ear 18.

3. *Microgale Talazaci*, sp. n.

Closely related to *M. Dobsoni* in general external appearance as well as in the conformation of the skull and teeth; but, besides being of much larger size, the colour of the skin is darker, being dark coppery brown, the centre of the back blacker.

Type and unique specimen (M. 1293), ♀, from the forest of the Independent Tanala of Ikongo, in the neighbourhood of Vinanitelo, one day's journey south of Fianarantsoa, May 22, 1896.

Measurements in millimetres:—

Head and body 124; tail 119; manus 14; pes 23; length of ear 16·5.

Length of skull 33·5; breadth across maxillary zygomatic processes 13; interorbital breadth 6·7.

Dedicated to the Rév. Père Talazac, S.J., of Tandrakazo (S. Betsileo).

4. *Microgale longirostris*, sp. n.

In coloration like *M. Thomasi*. Muzzle much produced and attenuated. Whilst in the last-named species, as well as in *M. longicaudatus* and *M. Cowani*, the contour of the skull is cylindrical, it is somewhat pyriform in shape in the present species, the cerebral cranium being comparatively broader, the facial cranium slenderer and more elongated, the latter character applying as well to the lower jaw, which is slenderer and more attenuated than in either *M. longicaudatus* or *M. Cowani*. The dentition is weaker than in *M. Cowani*, the secondary cusps more reduced than even in *M. longicaudatus*. Hind foot remarkably long.

Dimensions in millimetres :—

Length of head and body 69; length of tail 54; length of manus 9; length of pes 18·5; length of ear 14·5.

Type and only specimen, ♀ (M. 490), a dry skin, with the skeleton complete, from the neighbourhood of Ampitambè, 4th July, 1895.

Local names *forimenjy*, *rainijora*.

5. *Oryzoryctes gracilis*, sp. n.

Coloration of the skin as in *O. tetradactylus*, *M. Cowani*, &c. The claws of the pentadactyle manus smaller and less curved than in *O. tetradactylus*. Though the skull is longer than in *M. Thomasi*, its frame is much more slender, and by the elongation of the facial cranium and lower jaw, as well as by the delicate teeth, it very much recalls the skull of *Hemicentetes* in miniature. The anterior upper and lower premolar separated by a wider interspace from both the canine and the second premolar than in any other known member of the family, *Hemicentetes* and *Centetes* excepted. This remark applies as well to the two outer upper and the last lower incisor, with regard to the teeth immediately preceding and following them. The outer margins of the upper molars are more deeply notched than in all other known Centetidæ.

Dimensions in millimetres of type specimen in spirit (M. 184):—

Length of head and body circa 93; length of tail 81; length of manus 11·5; length of pes 18; length of ear 16.

Type from Ambohimitombo forest, Nov. 1894; a second specimen (skeleton) from Ankeramadinika forest, obtained by Dr. Moss.

N.B.—By the non-fossorial character of the claws this

animal approaches the known species of *Microgale* (*M. crassipes*, M.-Edw., excepted) more than those of *Oryzoryctes*; but by the characters of the skull and teeth it is different from either, and would have better claims to be placed in a distinct genus than the different forms of *Microgale*. To avoid this the name of *Oryzoryctes*, being the older one, is provisionally adopted here.

6. *Oryzoryctes niger*, sp. n.

Very much like *O. tetradactylus* in general appearance, but entirely black above, with a more greyish tinge beneath. Fur as in the former, somewhat less soft than in *O. hova*. Head a little broader behind and muzzle less produced than in *O. tetradactylus*. Fore foot tetradactyle; claws as in *O. tetradactylus*, slightly shorter than in *O. hova*. The skull is somewhat intermediate in shape between those of *O. tetradactylus* and *O. hova*, though approaching closer to that of the former, from which it is, however, at once to be distinguished by the slightly broader cerebral cranium.

Dimensions in millimetres of type specimen, ♀ (M. 357):—

Length of head and body 106; length of tail 49; length of manus 10·5; length of pes 16·5; length of ear 12·5.

Marshes near Sirabè (type specimen), native name *voalavorano*; Ampitambè.

BRACHYUROMYS, gen. nov.

(Fam. *Muridæ*.)

Skull broad and massive. Upper profile of cerebral cranium flattened. Supraorbital crests rounded off. Incisors and rooted molars ($\begin{smallmatrix} 3-3 \\ 3-3 \end{smallmatrix}$) large as compared to the size of the skull. Crowns of molars flattened, not tuberculate. In young specimens the crowns of the molars show three lobes of enamel, united by cement and obliquely disposed (inclining forwards with their outer portion), the posterior lobe in the upper, the anterior one in the lower molars being the smallest. These lobes soon unite together, forming various patterns, by which the different species may be easily distinguished. Tail shorter than usual in *Muridæ*. By their broad, moderately flattened, roundish heads and comparatively short tails these Rodents recall somewhat the Voles in outer appearance.

Type *B. ramirohitra*. Bartlett's "*Nesomys betsileoensis*"* also belongs to this genus.

* P. Z. S. 1879, p. 770.

7. *Brachyuromys ramirohitra*, sp. n.

Ears large, oval. Coloration of upper parts brown, abundantly mixed with black, on the sides less dark, the black hairs gradually diminishing. Lower parts fawn. Basis of hairs slate-coloured. Tail furnished above with black, beneath with grey hairs. Parietal crests diverging anteriorly. Interparietal short in transverse, but longer in antero-posterior diameter than in *B. betsileoensis*. Molars very large, all about of equal size, the third in both jaws generally slightly smaller than the other two; the third upper one slightly triangular. The pattern presented by the uniting of the three enamel-lobes is as follows in moderately worn teeth:— In the two upper anterior molars: (1) an anterior enamel-loop, open on the inner side and running obliquely across the crown, close up to the outer enamel-margin of the tooth; (2) a posterior enamel islet, smaller in transverse extent than the anterior loop and almost parallel to it. In the last upper molar the anterior loop is shut out very soon from the inner side, so that this tooth presents two obliquely transverse enamel islets, with sometimes a third smaller one, behind. In moderately worn lower molars the shorter anterior loop opens on the inner, the longer posterior loop on the outer side, the latter remaining open for a longer time than the former.

Dimensions in millimetres:—

	Skin (M. 429), ♂, type.	Skin (M. 509), ♂.	M. 181, jun. (in spirit). c. 110
Length of head and body..	165	162	
„ tail	99	89	73
„ manus	15	16	16
„ pes	34	52	27
„ ear	24	24	17

Dimensions in millimetres of skull (M. 789, ♂):—

Basal length 32·5; length of nasals in middle line 13·5; length of frontals in m. l. 13·5; length of parietals in m. l. 6·3; interorbital breadth at narrowest 4·7; length of upper molar series 8·5; length of lower molar series 8·5; length of interparietal in middle line 5·2; breadth of skull between zygomatic arches 23·5.

Loc. Ampitambè forest, Betsimisaraka country (on the border of N.E. Betsileo), 6 hours S.E. of Fandriana.

Native names *voalavoanala*, *ramirohitra*.

Fossil in the lower deposits of the Children's Cave (Sirabè).

Gymnuromys, gen. nov.
(Fam. Muridæ.)

Molars $\frac{3}{3}$, with flat, not tuberculate crowns, their patterns presenting a superficial resemblance to *Myoxus nitela*. Molars exceedingly small as compared to the size of the skull and the whole animal, forming two parallel rows in the upper jaw; last molar largest in both jaws.

8. *Gymnuromys Roberti*, sp. n.

Upper parts black-grey, almost slate-coloured; laterally with the admixture of a few white hairs; beneath white or yellowish white. Tail scaly, almost naked, the small stiff hairs being more scanty than even in *Mus rattus*. Ears large, acute oval. Snout produced. Whiskers very long (55-58 millim.). Skull low, narrow, and elongated; no supraorbital crests; parietal crests lyriiform in shape. The crowns of the molars present from 4 to 6 transverse narrow loops; in the upper molars one of these remains open on the inner margin till the teeth are much worn, whilst they are all shut out from the outer margin at a much earlier stage. In the lower molars these loops are somewhat more complicated, sometimes two joining together and thus forming irregularly ramified patterns; they remain for a longer time open on both sides than in the upper molars. Much worn molars present nothing but central islets, arranged somewhat irregularly, but preserving on the whole the transverse direction.

Pregnant females obtained on June 24th and July 17th; two fetuses in each case.

Dimensions in millimetres:—

	M. 446, ♀ (type).	M. 510, ♂.
Length of head and body ..	160	150
„ tail	165	167
„ manus	15	15.5
„ pes	34	35
„ ear	20	21

Dimensions of skull (M. 729, ♂):—

Basal length 35; length of nasals in middle line 16.3; length of frontals in m. l. 13.5; length of parietals in m. l. 6.5; interorbital breadth at narrowest 5; length of upper molar series 5.8; length of lower molar series 6.5; length of interparietal in middle line 4.5.

Ampitambè forest.

Native name *voalavoanala*.

9. *Chirogale Sibreei*, sp. n.

On the whole resembling *Chirogale Milii*, Et. Geoffr., but smaller, and presenting differences in the skull. Coloration of fur silvery grey, with here and there a slight addition of fawn. Beneath whitish.

Dental formula.—I. $\frac{2}{2}$, C. $\frac{1}{1}$, P. $\frac{3}{3}$, M. $\frac{3}{3}$.

Skull smaller, but in some of its transverse dimensions comparatively broader than in *C. Milii**. Parietals more globose than in the latter. The maxillaries are hollowed out in front of the lacrymals, a character not observed in *C. Milii*. In the form of interparietal more approaching *Opolemur*† than *C. Milii*.

Three adult specimens were obtained from the neighbourhood of Ankeramadinika (one day's journey to the east of Antananarivo); one of these, which had been kept alive for the purpose of taking measurements in the flesh, was lost.

Dimensions in millimetres of skull and teeth of type, ♂ (M. 839):—

Basal length	42.5 (<i>C. Milii</i> 49 & 50)†
Length of nasals in middle line	19
" frontals " "	14
" parietals " "	13.5
" interparietal " "	6.5
Breadth across zygomatic processes ..	31
Breadth between procc. postauditor. of squamosum	24.5
Breadth across parietals	23.5
Breadth behind postorbital processes of frontals	14.6
Interorbital breadth at narrowest	8
Breadth between post. basis of upper canines	10.5
Length of upper dental series (m_3 —ant. basis of canine).....	18.2
" upper molars	8.5
" upper premolars	6.5
" lower dental series (m_3 —ant. basis of canine).....	16
" lower molars	9.5
" lower premolars	4

* See dimensions of *C. Milii* in Forsyth Major, "Ueber die malagassischen Lemuriden-Gattungen *Microcebus*, *Opolemur*, und *Chirogale*," *Novitates Zoologicae*, vol. i., Jan. 1894, pp. 28-31.

† *L. c.* pp. 20, 21.

† *L. c.* p. 29.

XLIX.—*On the Rhizopodal Genera Webbina and Vitriwebbina.* By FREDERICK CHAPMAN, A.L.S., F.R.M.S.

THE tests of the Reticulate Rhizopoda usually exhibit three kinds of shell-structure, and this difference forms an essential element in the classification of the Foraminifera as they are at present understood:—(a) The *porcellaneous* test is opaque milky white and by transmitted light of a translucent brown or horn-colour, without minute foramina in the external wall. (b) The *arenaceous* test is composed of sand-grains, sponge-spicules, or other foreign material, embedded in a chitinous cement, and with or without perforations in the external shell-wall. (c) The *hyaline* or *vitreous* test is more or less transparent, sometimes with a glassy surface, and with innumerable fine tubules perforating the shell-wall or test and more or less at right angles to the surfaces.

The genus *Webbina*, when first brought into use, was made to include those Foraminifera which consist of a series, straight or curved, of hemispherical or elongate or of single chambers essentially adherent to foreign bodies. The shell-structure was at the time overlooked, and only indistinct ideas can be gathered about many of the types from the description given of the superficial appearance of the test.

It is therefore advisable that a review of the genus should be made, in order to discuss some of the chief points with regard to the priority of authorship and the grounds for retaining the genus *Webbina*.

The generic name was given by d'Orbigny in 1839*, to include an adherent foraminifer with a rough exterior which he found in sand off the island of Teneriffe. This species he named *Webbina rugosa*; but in the diagnosis of the genus no clue was given which would enable anyone to form an opinion as to the nature of the test. Indeed, this essential point of shell-structure in the description of Foraminifera was generally overlooked until Carpenter, Jones, and Parker conducted their elaborate researches upon it. Subsequently d'Orbigny described two other specimens under the names of *Webbina flexuosa* and *W. irregularis*† which had previously been figured by Cornuel‡ as “eggs of molluscs,” and which

* d'Orbigny, A. D., “Foraminifères” in Barker-Webb and Berthelot's ‘Histoire naturelle des Iles Canaries’ (Paris, 1839), vol. ii. part 2, p. 125, pl. i. figs. 16–18.

† d'Orbigny, A. D., ‘Prodrome de Paléontologie stratigraphique universelle des Animaux mollusques et rayonnés’ (Paris, 1850), vol. ii. p. 111, nos. 782, 783.

‡ Cornuel, J., “Description de nouveaux fossiles microscopiques du

he had found in the Cretaceous beds of the Haute-Marne Department. These three species of *Webbina* were described by d'Orbigny as to their form and superficial texture, but the nature of the test, which is so important in grouping the Foraminifera, seems to have been quite overlooked. These specimens have been referred to as arenaceous forms*; but there are no grounds for the supposition. Terquem follows in 1862†, and records several species of *Webbina* from the Infra-Lias of the departments of the Moselle, of the Ardennes, and from the east of Belgium; but concerning these forms also we are doubtful as to their textural characters, and they are perhaps mainly referable to *Nubecularia*. Von Reuss in 1862‡ refers to *Nubecularia irregularis* as occurring in the "Speeton Clay" of North Germany. From his description there is very little doubt that Reuss's specimens belong to *Vitriwebbina* (the hyaline form of *Webbina*). Professors Jones and Parker, in 1865§, were the first authors to refer to *Webbina* as a subtype of *Trochammina*, and they retain *Webbina irregularis* as the type "with its varieties *W. clavata* &c.," supposing these to be arenaceous. In 1866 Jones, Parker, and Brady|| described *Webbina* as a subgenus of *Trochammina*, and give the following as the general characters of the genus:—"Shell adherent, comprising one or more pyriform, oval, or round chambers, subarenaceous, smooth, dirty white, or of a deep rusty colour, and, when numerous, arranged in a single irregular moniliform line, often branched." At the same time these authors described a new species, *W. hemisphaerica*, from the Coralline Crag of Suffolk. Dr. H. B. Brady, in 1884 (*op. cit.* p. 66), treated *Webbina* as

terrain crétacé inférieur du département de la Haute-Marne," *Mém. Soc. géol. France*, sér. 2, vol. iii. 1848, p. 250, pl. ii. figs. 36 (right-hand figure) and 37.

* Brady, H. B., "Report on the Foraminifera dredged by H.M.S. 'Challenger' during the years 1873-1876," *Reports of the Scientific Results of the Voyage of H.M.S. 'Challenger,'* vol. x., Zoology (London, 1884), p. 348.

† Terquem, O., "Recherches sur les Foraminifères de l'étage moyen et de l'étage inférieur du Lias," *Mém. II., Mém. Acad. Imp. Metz*, vol. xlii. 1862, pp. 455-459, pl. vi. figs. 15-19.

‡ Reuss, A. E., "Die Foraminiferen des norddeutschen Hils und Gault," *Sitzungsb. d. k. Ak. Wiss. Wien*, vol. xvi. Abth. i. 1862 (1863), pp. 30, 31.

§ Parker, W. K., and Jones, T. R., "On some Foraminifera from the North Atlantic and Arctic Oceans, including Davis Straits and Baffin's Bay," *Phil. Trans. Roy. Soc.* vol. clv. 1865, p. 435.

|| Jones, T. R., Parker, W. K., and Brady, H. B., 'A Monograph of the Foraminifera of the Crag,' Part I., *Palæontographical Society*, vol. xix. for 1865 (1866), pp. 25-27.

a genus of the subfamily *Trochammininae*, and retained the genus in the arenaceous series. Previous to the last-named author Dr. Sollas, in 1877 *, finding certain Foraminifera resembling *Webbina* in the Cambridge Greensand, but exhibiting a tubulated structure in the shell-wall, proposed to reserve *Webbina* for the hyaline or perforate type of the adherent moniliform series of ovoid chambers, whilst the truly arenaceous forms, such as *W. clavata*, P. & J., he suggested should be relegated to the genus *Trochammina*. This change would necessitate considerable alteration in the accepted nomenclature of the group, and, further, would not distinguish the adherent few-chambered forms from the free many-chambered and coiled species, although such distinctions are not necessary and, indeed, are not uniformly adhered to in the classification of the Foraminifera.

To meet the difficulty arising from the existence of two distinct types of Foraminifera having the similar external form but exhibiting a fundamental difference in the character of the shell-wall, the writer proposed *Vitriwebbina* in 1892 † as a genus, to include the species with a perforate type of shell. In the same year Dr. Perner described specimens of the perforate type of *Webbina* which he had obtained from the Cenomanian strata of Bohemia ‡. These specimens he referred to *Trochammina irregularis* (P. & J.), Carpenter, and remarked at the same time that it is doubtful if the other species are imperforate §.

From the long usage of the generic term *Webbina* to include the finely arenaceous forms with adherent pyriform or rounded segments, according to the definition given by Jones, Parker, and Brady in 1866, it now appears unnecessary to revert to the types of the original authors, since the originator of the generic term did not clearly define the limits of the

* Sollas, W. J., "On the Perforate Character of the Genus *Webbina*, with a notice of Two new Species, *W. laevis* and *W. tuberculata*, from the Cambridge Greensand," *Geological Magazine*, dec. ii. vol. iv. [1877] pp. 102-105, pl. vi.

† Chapman, F., "Some new Forms of Hyaline Foraminifera from the Gault," *Geol. Mag.* dec. iii. vol. viii. [1892] pp. 52-54, pl. ii.

‡ Perner, J., "Ueber die Foraminiferen des böhmischen Cenomans" ["Foraminifery Českého cenomanu"], *Česká Akademie Císaré Františka Josefa* (Prague, 1892), *Palaeontographica Bohemiae*, no. 1, p. 53, pl. ix. figs. 1-6.

§ Dr. Perner informs me that he has subsequently seen some of the original specimens of *Webbina* in d'Orbigny's collection, and finds that they have a perforate shell-wall. This evidence alone would not, however, be sufficient for establishing the genus as one of the hyaline group, since d'Orbigny included different and distinct types in his series.

genus (see the Stricklandian Rules for Zoological Nomenclature, § 5).

Amongst those arenaceous Foraminifera which can without hesitation be assigned to *Webbina irregularis* (for it is quite permissible to assume that d'Orbigny's original specimens were arenaceous from the description) we can mention two. Häusler figured a specimen in 1882* from the Swiss Jurassics which consisted of two chambers, one of which was broken; but the test, when complete, would show the characters of the original type species, as far as concerns the contour and arrangement. The specimen from the Carboniferous Limestone of the north of England which Howchin figured in 1888† is another example about which there is no doubt as to its arenaceous character; and in this case the specimen possesses as many as eight chambers.

The above is by no means exhaustive of the recorded occurrences of the adherent organisms referred to *Webbina* or the allied group of *Trochammina*; but it is presumed that enough has been given to show the amount of obscurity in which the genus *Webbina* has hitherto been involved. For further references consult Sherborn's 'Index to the Genera and Species of the Foraminifera,' under *Webbina* and *Trochammina*.

Many of the genera of the Foraminifera separated by the difference in the type of shell-structure mentioned at the beginning of this paper are found to agree with one another in their external form alone. These are referred to as isomorphous genera. There are, however, certain genera which at first sight possess isomorphous characters, but which on careful examination show differences which were before unsuspected; and this is the case with the genera *Webbina* and *Vitriwebbina*.

It is now proposed to show, by the light of many perfect specimens which have been recently obtained from the chalk, and the gault of Folkestone, that the test of the arenaceous *Webbina* is not isomorphous with the hyaline *Vitriwebbina*, although specimens of the latter, as they are usually found, are externally comparable with the former.

The test of *Webbina*, as defined by Brady in his classification of the Foraminifera in the Report on the 'Challenger' specimens (p. 66), is as follows:—"Adherent, consisting

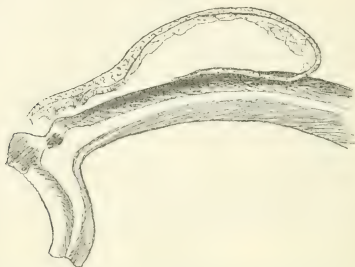
* Häusler, R., "Additional Notes on the *Trochammina* of the Lower Malm of the Canton Aargau, including *Webbina* and *Hormosina*," Ann. & Mag. Nat. Hist. ser. 5, vol. x. 1882, p. 353, pl. xv. fig. 15.

† Howchin, W., "Additions to the Knowledge of the Carboniferous Foraminifera," Journ. Roy. Micr. Soc. 1888, p. 539, pl. ix. figs. 16, 17.

either of a single tent-like chamber or of a number of such chambers connected by adherent stoloniferous tubes." The structure of the test as belonging to the *Trochammininae* is "thin, composed of minute sand-grains incorporated with calcareous or other inorganic cement, or embedded in a chitinous membrane; exterior smooth, often polished; interior smooth or (rarely) reticulated; never labyrinthic."

When a thin vertical section of the test of *Webbina clavata*, P. & J., is examined under a low power of the microscope the general form of the test is seen as in fig. 1. The cavity

Fig. 1.



Vertical section of the test of *Webbina clavata* attached to a piece of Gastropod shell. $\times 30$.

of the shell is always undivided, whereas in many of the linear-shaped *Nubecularia* the embryonic or primordial chamber shows a partial or complete septation, somewhat after the manner of the Milioline commencement of an *Articulina*. This character is shown in the figures of *Nubecularia tibia* from the clay (Liassic) of Chellaston which illustrate a paper by Professors Jones and Parker*. It will also presently be shown that *Vitriwebbina* often exhibits a polymorphine septation in its initial segment, and this can only be seen in the specimens which have the early chambers preserved from injury, and is usually met with in organisms which have affixed themselves in a recess of the stone to which they are attached†. *Vitriwebbina* thus shows an

* Jones, T. R., and Parker, W. K., "On some Fossil Foraminifera from Chellaston, near Derby," Quart. Journ. Geol. Soc. vol. xvi. 1860, p. 455, pl. xx. figs. 49-51.

† It may here be pointed out that some perfect specimens are met with which do not show any septate commencement; so that it is extremely probable that we have two types, one of an embryo and the other of a simple bud, according to the alternating series of generation in the Foraminifera.

affinity towards *Nubecularia*, but not to *Webbina* in this respect.

That *Webbina* is a genus closely allied to *Trochammina* is evident when a thin section is examined under a high power. Fig. 2 represents a portion of the test of

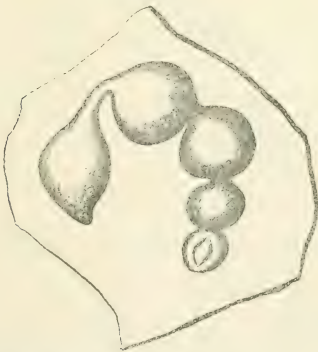
Fig. 2.



Portion of the test of *W. clavata* more highly magnified. $\times 360$.

a recent specimen of *W. clavata*; and it shows the arenaceous central layer glazed over internally and externally, the outer glazing being smoother, more evenly laid, and paler in colour than the inner. The median arenaceous layer

Fig. 3.



Vitriwebbina laevis (Sollas). Chalk, Charing, Kent. $\times 20$.

averages about $\cdot 027$ millim. in thickness and the inner and outer layers about $\cdot 002$ millim. each. There is also much chitinous material between the angular sand-grains and spicules, and the outer and inner layers of the shell are composed of the same substance. The grains of sand average $\cdot 014$ millim. in diameter.

In the specimens of *Vitriwebbina* which exhibit the secondary septation before referred to the first segment

resembles an attached *Polymorphina*, very like the figure of *P. concava* figured by Williamson* and also like the first segment of the *Ramulina cervicornis* of the Gault†. With regard to this latter it appears highly probable that the attached *Ramulina* and the *Vitriwebbina* are closely related.

Fig. 3 is a sketch of a specimen of *Vitriwebbina lævis* (Sollas) in which the primordial septation is very distinct. This specimen was found attached to a shell-fragment from the "Chalk detritus" of Charing, Kent, and probably of Chalk-marl age. It was substituted for a Gault specimen during the writing of this paper on account of the distinctness of the septate commencement, although many of the Gault specimens are nearly equally good.

Fig. 4 is a vertical section taken through two of the chambers of a Gault specimen of *Vitriwebbina tuberculata*, (Sollas). Here the tubulation of the shell-wall is clearly seen,

Fig. 4.



Vertical section of the test of *Vitriwebbina tuberculata* (Sollas). $\times 30$.

as well as the superficial tuberculations of clear shell-substance.

In recapitulation, an attempt has been made to show that:—

1. *Webbina*, as a genus, being originally ill-defined, it is necessary to follow the definition of the first authorities who placed the genus upon a substantial basis, which authors are Jones, Parker, and Brady, 1866.

2. Those examples of adherent Foraminifera which resemble *Webbina* externally, but which exhibit a tubulate shell-wall, should be retained in the genus *Vitriwebbina*.

* Williamson, W. C., "On the Recent Foraminifera of Great Britain," Ray Society, London, 1858, pl. vi. fig. 151.

† Geol. Mag. viii. 1892, p. 54, pl. ii. fig. 5.

3. The typical arenaceous *Webbina*, as far as I am acquainted with them, have simple non-septate chambers.

4. *Vitriwebbina* agrees isomorphically with *Nubecularia* in that both may exhibit septate commencements.

5. *Vitriwebbina* appears to be closely related to *Ramulina* (the adherent species of the genus) in having similarly septate Polymorphine commencements.

L.—Notes on the Genus *Byblia* (= *Hypanis*).

By GUY A. K. MARSHALL, F.Z.S., F.E.S.

THE following is the generic synonymy of *Byblia*:—

Byblia, Hübner, Verz. bek. Schmett. p. 28 (1816).

Byblis, Godart, Enc. Méth. ix. p. 327 (1819).

Hypanis, Boisduval, Faun. Madag. p. 55 (1833).

Personally I am quite at a loss to understand the objection raised by some entomologists to the recognition of certain of Hübner's genera on the ground that he failed to define them properly, seeing that at the same time they are quite prepared to accept such Fabrician genera as *Lycena*, *Colias*, *Hesperia*, &c., which are, if anything, even more open to that objection. But in the present instance there can be no doubt whatever as to what Hübner meant by his genus *Byblia*, for he cites *B. ilithyia*, Drury, as its sole representative, which seems to me to be as clear a definition as we can expect under the circumstances.

A careful examination of the long series of specimens in the British Museum, which are there divided into no less than seven species, has convinced me of the truth of Mr. Roland Trimen's opinion that all the Asiatic and continental African forms of *Byblia* are referable to a single species. Moreover I agree with M. Mabille in refusing specific rank to the Madagascar form, which, however, I do not regard as a mere variety, but as a subspecies, taking that term to signify a clearly localized variety, which does not occur in company with the type-form, but completely replaces it within a defined area, though still exhibiting sufficient intergrades linking it to that form to prevent its being regarded as a distinct species—in other words, a geographical race. The following is the synonymy of the single species and its various forms:—

1. *Byblia ilithyia* (Drury).

Papilio ilithyia, Drury, Ill. Ex. Ent. ii. t. xvii. figs. 1 and 2 (1773).

Papilio ilithuia, Fabr. Spec. Ins. ii. p. 97 (1781).

- Papilio polynice*, Cramer, Pap. Exot. iv. t. cccxxv. G and H. (1782).
Papilio goetzius, Herbst, Natur. Schm. ix. t. cclviii. figs. 1 and 2 [nec 3 and 4] (1798).
Papilio ilithya, Herbst, ibid. figs. 5 and 6 (1798).
Byblia ilithya, Hübner, Verz. bek. Schmett. p. 28 (1816).
Biblis ilithya, Godart, Enc. Méth. ix. p. 327 (1819).
Hypanis polynice, Boisduval, Spec. Gén. i. pl. ix. fig. 6 (1836).
Hypanis cora, Feisthamel, Ann. Soc. Ent. Fr. p. 249 (1850).
Byblia ilithya, Moore, Lep. Cey. p. 45, pl. xxiii. fig. 3 (1881).
Hypanis simplex, Butler, P. Z. S. p. 146, pl. xxiv. fig. 8 (1883).
Byblia ilithya, de Nic. Butt. Ind. ii. p. 15 (1886).
Byblia simplex, de Nic. ibid. p. 17 (1886).
Hypanis ilithya, Trimen, S. Afr. Butt. i. p. 264 (1887).

Var. *goetzius* (Herbst).

- Papilio ilithya*, Cram. Pap. Exot. iii. t. cccxiii. A and B, t. ccciv. C and D (1782).
Papilio goetzius, Herbst, Natur. Schm. ix. t. cclviii. figs. 3 and 4 [nec 1 and 2] (1798).
Hypanis ilithya, var. A, Trim. (part.) S. Afr. Butt. i. p. 264 (1887).

Var. *acheloia* (Wallengren).

- Hypanis ilithya*, Doubl. & Hew. Gen. Diurn. Lep. pl. lxviii. fig. 1 (1851).
Hypanis acheloia, Wallgr. K. Sv. Vet.-Akad. Handl., Lep. Rh. Caf. p. 29 (1857).
Hypanis ilithya, Wallgr. ibid.
Hypanis cora, var., Butl. P. Z. S. p. 177, pl. xviii. fig. 4 (1881).
Hypanis ilithya, var. *vulgaris*, Staud. Exot. Schmett. p. 106 (1885).
Hypanis ilithya, var. A, Trim. S. Afr. Butt. i. p. 264 (1887).
Byblia vulgaris, Butl. Ann. & Mag. Nat. Hist. (6) xviii. p. 73 (1896).

Var. *castanea* (Butler) *.

- Hypanis castanea*, Butl. P. Z. S. p. 759 (1885).
 ? *Hypanis anvatar*, Lefb. (nec Boisd.) Voy. Abyss., Zool. vi. p. 380 (1862).

1 (a). *Byblia ilithya-anvatar* (Boisduval).

- Hypanis anvatar*, Boisd. Faun. Madag. p. 56, pl. vii. fig. 5 (1833).
Hypanis ilithya, var. *anvatar*, Mab. Grand. Hist. Madag. (1886).

This variable species has a very extended range, occurring as it does throughout the Ethiopian Region and ranging through Arabia into India and Ceylon. Owing to the fact that in different localities it gives rise to several well-marked varieties, and that both the type-form and its varieties exhibit very pronounced seasonal differences, *B. ilithya* has been split up into many so-called species. With regard to the seasonal forms of this insect Mr. Butler says (Ann. & Mag.

* Another variety has been described by Mr. Aurivillius (Ent. Tidsk. xv. p. 279, 1894) under the name of var. *Crameri*; but I was unable to obtain access to his description during my short stay in England.

Nat. Hist. (6) xviii. p. 73) :—" I believe *B. acheloia* is supposed to be the extreme development of the dry-season form [of *B. ilithyia*] in South Africa. The puzzle to me is, Why should a species common to India and Africa produce totally different varietal forms in the two countries? As *B. vulgaris* only occurs in Africa, it can therefore only be supposed that in India the species produces two dry-season forms—*B. ilithyia* and *B. simplex*." Upon what foundation this singular belief is based I know not; but it certainly did not originate in South Africa. It is true that *B. acheloia*, Wallgr., was founded on dry-season specimens, but it represents the dry form of the variety usually known under that name, and *not* the dry form of typical *ilithyia*, its corresponding wet-season form being *B. ilithyia*, var. *vulgaris*, Stand., which Mr. Butler erroneously considers to be a distinct species. The reasoning contained in the latter half of the above quotation is far too subtle for my comprehension, for I quite fail to perceive that the restriction of a certain variety of *ilithyia* to the African continent must necessarily imply that in India that species produces only two dry-season forms and no wet-season one. Surely this is but a "lame and impotent conclusion," and were there any truth in it, it would be a far greater puzzle than that propounded by Mr. Butler, which latter seems to me but a very simple matter after all.

The real relation of these various forms is as follows :—The type of the species was a wet-season specimen as far as can be judged from Drury's somewhat crude figure, which is founded on a West-African example, and Cramer's figure of his *polynice* belongs to the same form. During the dry season in Africa the underside assumes a very different appearance, the colouring being more or less rich ferruginous, with three transverse macular white stripes, viz. subbasal, median, and submarginal. Curiously enough this form appears to have escaped the infliction of a specific name. In India the change is not nearly so marked, but the dry-season form has been described under the name of *simplex*, Butl. Mr. Butler notes that the British Museum specimens of the latter form were all caught in February and those of the typical form in April, May, and October, which is quite in accordance with my contention that they are seasonal forms of one species. I am, however, aware that Mr. de Nicéville, in his fine book on the Indian butterflies, records Col. Swinhoe's statement that he has taken the *simplex* form practically all the year round, on the strength of which he retained it as a distinct species. But in a later paper he unites the two forms (Journ. As. Soc. Beng. 1889), for, as he there shows,

Col. Swinhoe was evidently unable to distinguish one from the other, and therefore his evidence as to the occurrence of the dry-season form at all times of the year can hardly be considered of any weight. Therefore in Africa :—

Wet-season form.		Dry-season form.
<i>B. ilithyia</i> , Drury	=	(Unnamed).
(<i>B. ilithyia</i> , var. <i>vulgaris</i> , Staud.)	=	<i>B. ilithyia</i> , var. <i>acheloia</i> , Wallgr.

And in India :—

Wet-season form.		Dry-season form.
<i>B. ilithyia</i> , Drury	=	(<i>B. simplex</i> , Butl.).

The recognition of the seasonal forms of this species in South Africa has hitherto been based only on observations in the field; but I am now glad to record that my friend Mr. J. M. Hutchinson, of Natal, has lately succeeded in proving it by breeding experiments. While staying with him in February of this year we obtained a number of eggs laid by the wet form of *ilithyia*, which emerged in the end of March and beginning of April as the same form. Mr. Hutchinson then secured eggs from this latter brood and succeeded in getting fourteen of them as far as the pupa stage, though many of the larvæ were stunted owing to the great difficulty of finding food for them on the parched veldt. As a result of this starving only one out of the fourteen pupæ emerged properly, though a number attained their full development in the pupa but had not sufficient vitality to emerge. All these specimens, however, exhibited in miniature the unmistakable deep ferruginous white-striped colouring on the underside of the hind wings characteristic of the dry-season brood. The single specimen which emerged is a somewhat dwarfed female. The underside is of a lighter ferruginous than usual and closely resembles that part in the Indian dry form. On the upperside the extraordinary reduction of all the black bands gives it a very singular appearance, the broad submarginal band in the hind wing being reduced to a narrow macular line, and the same feature in the fore wing being almost obsolete. But at the same time in the hind wing the median blackish line, which is only faintly indicated in normal specimens, is here strongly marked, and the enlarged marginal spots of ground-colour are each clouded centrally with a fuscous patch, which is large and distinct in the three lowest, but gets smaller and fainter towards costa.

As a general rule the upperside black markings are almost the same in winter as in summer; but this season many

specimens exhibit a marked reduction, and, indeed, since my arrival in Natal in August I have noticed that the dry-season forms of many other species are, so to speak, "drier" than usual—that is, they are smaller and more under-coloured. As this year in Natal the summer was unusually dry and hot, and was followed by a very mild winter, it strengthens my belief that in South Africa the development of black markings depends not so much on temperature as on humidity. The occurrence of the wet-season form in South Africa may be roughly given as from September to April and that of the dry form from April to September, though, of course, allowance must be made for exceptional seasons and a certain amount of overlapping.

It is interesting to note that wherever *B. ilithyia* occurs in the Ethiopian Region it is accompanied by a well-marked variety, whereas in the Oriental Region it gives rise to no variety at all.

All the varieties may at once be distinguished from the typical form by the absence of the transverse row of black spots before middle on the upperside of hind wing, in addition to other characters, and so far as I have seen they never exhibit any graduation into the typical form, though they merge very much into one another. There are three well-marked continental varieties, which are more or less confined to certain distinct areas:—

(a). Var. *acheloïa*, Wallgr.

This is the southern variety, and is the only one found in the South-African subregion. On the eastern side it ranges northwards to Nyasaland, and perhaps even as far as the Equator, but on the West Coast the Cunene River appears to be its northern boundary. Apart from the distinctive character mentioned above, *acheloïa* differs from *ilithyia* in having all the black bands on both surfaces more strongly developed at all seasons and the hind marginal spots on upperside of hind wing are smaller; on the underside of the hind wing it differs in the wet season in the absence of the subbasal and median whitish bands; these are, however, present in the dry form, which only differs from that of the type in the absence of the hind marginal lunulate white line in both wings. Hewitson's figure of *B. ilithyia* (Doubl. Gen. Diurn. Lep. pl. lxxviii. fig. 1) represents the wet form of this variety.

In South Africa the distribution of *acheloïa* is somewhat curious. In the warmer low-lying districts, and

especially along the coast-belt, it is the prevailing form, typical *ilithyia* only occurring very rarely, whereas on the plateaux of the interior the position is exactly reversed. This distinct localization of the two forms, combined with the fact that I have never been able to find any intergrades linking them together, led me at one time to believe they were specifically distinct; but the matter has now been decided by the fact that Mr. Hutchinson in April last bred a specimen of the wet-season form of the var. *acheloïa* (= *vulgaris*) from an egg laid by typical *ilithyia*. In April 1893 I took a very curious sport of this variety on the Biggarsberg (about 5000 feet), in Natal, in which the underside of the hind wings was of a deeper ferruginous than usual and had completely lost all trace of the three white bands.

(b). Var. *goetzius*, Herbst.

This is essentially the West Coast and Central African variety and differs chiefly from *acheloïa* in having the hind marginal black bar of the fore wing continued right up to the costa, so as to give it the appearance of a broad marginal border enclosing a row of small spots of ground-colour similar to that in the hind wing. This, however, is a variable character, and every intergrade can be found linking it to *acheloïa*, though the extremes present a very different appearance. Herbst's figure of his male *goetzius* (Nat. Insek. Schm. ix. t. clviii. figs. 1 and 2) clearly represents a specimen of typical *ilithyia*, the female, however (figs. 3 and 4), representing the type of his variety.

(c). Var. *castanea*, Butler.

This is the north-eastern variety, being recorded at present only from Abyssinia, Somaliland, and Aden. It was founded on dry-season specimens, and that is the only form that I have seen. On the upperside it resembles var. *acheloïa*, but has much narrower discal black bands, and consequently much larger submarginal spots in secondaries; the central white band on the underside of hind wings is distinctly angulated, thus constituting an interesting link to the Madagascar subspecies *B. ilithyia-avvatarā*, Boisd.

In the upper districts of Natal the food-plant of *B. ilithyia*

is a small species of nettle which grows on the open veldt. The spiny green ova are deposited on the smaller leaflets, with which they assimilate wonderfully well. The larval stage is interesting in that it exhibits a very curious instance of dimorphic coloration. The two forms are as follows:—

(1) *Green form.*

Length about 1 inch. Dull green, with a double light yellowish central line. Each segment has on its anterior edge three black spots, one in the middle of central line and the others on each side of it. A very indistinct narrow lateral line of pale green. A small brownish dot on each segment below lateral line, those on thoracic segment being larger. Each segment has a transverse row of six dorsal tubercles, from each of which springs a stout spine; about halfway up this is a whorl of five smaller spines; stem of main spine green, apices of small spines broadly blackish. A similar smaller branched spine just above the legs entirely pale green. Whole of upper surface closely covered with minute white setigerous tubercles. Head green, with eyes and a broad frontal stripe brownish black; green portion studded with short whitish bristles, the longer ones being black-tipped. On vertex two long blackish branched spikes, longer than those on abdomen and markedly clubbed at apex.

(2) *Black form.*

Ground-colour dull black, with a broad pale yellow median stripe, divided centrally by a narrow black line; a broad, irregular, reddish-brown lateral stripe, ill-defined along its superior edge; this stripe has on each abdominal segment three downwardly oblique black lines, of which the upper one is longest and passes through spiracle, and the middle one is very short. Ventral area, legs, and prolegs black, the latter pale at apex. Head black, with short whitish bristles.

The meaning of this dimorphism is at present by no means clear to me. The green form is well protected by its assimilation to the hairy green leaf of the nettle, but the black one is a very conspicuous object on the food-plant. At first I suspected that it might be a matter of sex, the female being the protected form. But, unfortunately for my theory,

Mr. Hutchinson has bred both males and females from both forms, which appear to be equally common and which retain their respective types of coloration from the first moult. The question moreover is complicated by the occurrence of a similar dimorphism in the pupal stage, which, however, appears to be quite independent of the larval coloration. I have not seen the green form, which is the normal one, but it has been described by Mr. Trimen (from a single example), who gives the colour as "greenish grey, antennæ-cases pale yellowish." Mr. Hutchinson tells me that, with two exceptions, his larvæ, amounting to about fifty in all and comprising about equal quantities of both forms, all assumed a clear green colouring, though some of them showed a tendency to fuscous clouding. The two exceptions were coloured as follows:—Head, thorax, and wing-covers deep velvety black; a broad sinuate stripe along margin of latter and a large pear-shaped patch on posterior slope of the thoracic ridge dull creamy; the whole of abdomen brownish pink. Of these two pupæ one was green in the larval stage and the other black. Only one of them emerged, which proved to be a perfectly normal wet-season female. It is perhaps worth noting that in the specimens bred by Mr. Hutchinson the females stood to the males in the proportion of three to one, though, speaking from memory, I should say that the males are the more plentiful in the field.

Estcourt, Natal,
August 28, 1896.

LI.—*Descriptions of new Batrachians collected by Mr. C. F. Underwood in Costa Rica.* By G. A. BOULENGER, F.R.S.

Hylodes Underwoodi.

Tongue oval, entire. Vomerine teeth in two oblique groups behind the choanæ. Snout obtusely pointed, slightly projecting beyond the mouth, as long as the diameter of the orbit; canthus rostralis obtuse; loreal region concave; nostril much nearer the tip of the snout than the eye; interorbital space broader than the upper eyelid; tympanum very distinct, nearly as large as the eye. Fingers and toes slender, quite free, with very small disks and strong subarticular tubercles; first finger not extending beyond second; two prominent metatarsal tubercles, inner oval, outer round. Tibio-tarsal articulation reaching a little beyond the tip of the snout. Skin of upper parts rough with small tubercles, some of

which are confluent into short folds; belly smooth. Pale brown or grey above, spotted and marbled with darker; upper surface of snout sometimes whitish; a dark streak from the canthus rostralis to the edge of the mouth and two or three from the eye; a dark triangular spot between the eyes; an angular dark band, light-edged behind, may extend across the anterior dorsal region; a blackish lumbar spot; limbs with more or less angular dark cross-bands; inguinal region and sides of thighs tinged with carmine. Male with internal vocal sacs.

From snout to vent 30 millim.

Several specimens from La Palma.

Hylella puncticrus.

Tongue circular, entire. Head broader than long; snout rounded, shorter than the diameter of the orbit; canthus rostralis indistinct, loreal region concave, very oblique; nostril nearer the tip of the snout than the eye; interorbital space broader than the upper eyelid; tympanum distinct, one third the diameter of the eye. Fingers with large disks, larger than the tympanum, the two outer one-third webbed; toes with smaller disks, three-fourths webbed. Tibio-tarsal articulation reaching the tip of the snout. Skin smooth, feebly areolate on the belly. Head and back purplish blue (green?) or yellowish, finely speckled with purple; limbs colourless or finely speckled with purple; antebrachium and crus, and sometimes also pelvic region and thigh, scantily dotted with dark purple; upper lip and lower parts white.

From snout to vent 26 millim.

Two specimens from La Palma.

Spelerpes subpalmatus.

Palatine teeth in two slightly arched series, not extending outwards beyond the choanæ, and separated from the parapsenoid teeth, which form a single patch. Head moderate, much depressed, longer than broad; greatest width at angles of jaws; snout rounded, without canthus; eye moderately large. Body cylindrical, elongate, thrice as long as the distance from tip of snout to gular fold. Limbs short, widely separated when pressed against the body; fingers and toes short, depressed, obtuse, webbed at the base. Tail cylindrical or slightly compressed, very fragile; when intact, longer than head and body. Skin smooth and shiny, closely pitted; no parotoids; gular fold distinct; twelve costal grooves. Grey or grey-brown above, speckled or marbled

with darker and lighter; back sometimes uniform reddish brown; belly dark brown or blackish, speckled with whitish; tail with reddish spots, or entirely red or orange above.

From snout to vent 50 millim.; head 11; width of head 8; tail 70; fore limb 12; hind limb 12.

Several specimens from La Palma.

Erratum ('Annals,' September 1896, p. 233).

For *Lygosoma ocellatum* read *Lygosoma ocelliferum*.

LII.—*On Two new Species of Ablepharus from North Queensland.* By R. BROOM, M.D., B.Sc.

THE following species of *Ablepharus*, which have not, I think, been previously observed, were found by me recently near the North Queensland township of Muldiva. This little mining township, now almost completely deserted, is situated about 70 miles west of Herberton, near the watershed of the Walsh and the Tate.

Ablepharus tenuis, sp. n.

Body elongate, depressed; head rather flat. Snout short, obtuse, rostral slightly projecting. Eye not completely surrounded by granules; granules absent in the region of second and third supraciliaries and anterior half of subocular. Rostral in contact with the fronto-nasal by a short suture. No supra-nasal. Præfrontals, fronto-nasal, and frontal meet each other at a point. Frontal moderate, in contact with the first supraocular. Three supraoculars, first largest, about equal to frontal. A pair of fronto-parietals, very little shorter than the frontal, and in contact with the three supraoculars. Interparietal distinct, a little smaller than the fronto-parietals. Parietals moderate, meeting behind the interparietal. One pair of nuchals. Four supraciliaries, the first largest. Four upper labials in front of the large subocular. Ear-opening small, about $\frac{1}{3}$ the size of the eye, practically round and with no lobules. 24 scales round the middle of the body, subequal. One pair of præanals very slightly enlarged. Limbs feeble, not meeting when adpressed, both pentadactyle. Tail a little longer than the head and body.

To the naked eye the upper surface appears uniformly

brown, but, microscopically each scale is seen to be golden brown, with near the middle of its posterior edge an irregular black spot. Inferiorly yellowish grey below head and neck, bluish grey in abdominal region; under surface of tail dark grey, each scale having some irregular brownish spots.

	millim.
Total length	66·5
Head	5
Width of head	3·5
Body	24
Fore limb	6
Hind limb	9·5
Tail	37·5

Loc. Muldiva, North Queensland.

Ablepharus ornatus, sp. n.

Body elongate, subcylindrical. Snout short and pointed; the facial region considerably deflected from the plane of the parietal. Eye entirely surrounded by uniform granules, about 19 in all. Rostral in contact with the fronto-nasal by a very short suture. No supra-nasals. Fronto-nasal small, about equal to the præfrontals, which meet with an oblique suture. Frontal moderate, in contact with first supraciliary and with first supraocular. Three supraoculars, the first larger than the other two together; the large first supraoculars of each side approach each other so closely in the middle line as in one specimen to be practically in contact between the frontal and the fronto-parietal. Six supraciliaries, the first the largest. Fronto-parietals fused, rather shorter than the frontal. Interparietal distinct, about equal in size to the fronto-nasal. One or two pairs of very slightly enlarged nuchals. Three upper labials in front of the subocular, the first small. Ear-opening moderate, oblique, oval, without lobules. 26-28 scales round the body, dorsals enlarged, lower lateral scales small. One pair of enlarged præanals. Both limbs pentadactyle, hind limb when adpressed reaches wrist of fore limb. Tail about one and a half times the length of head and body.

All the dorsal region light fawn-coloured, uniform or with a few very small irregular dark spots; upper surface of the head with a faint golden lustre. Along the upper third of each lateral region passes a dark brown interrupted strip broken into small irregular squares by alternating fawn-coloured squares; the little dark squares are for the most part united by a fine dark line along their lower sides. This dark

lateral band passes in front of and behind the eye, but does not touch the granules encircling the eye, which remain light-coloured. Along the lower third of the lateral region is a regular series of irregular darkish spots or mottlings. Along the middle lateral region passes a narrow light-coloured strip free from any spots. Under surface very light fawn; in abdominal region a bluish tinge is present, probably due to the subjacent viscera. Upper and lower labials dark-edged.

	Spec. A. millim.	Spec. B. millim.
Total length	79	74
Head	8	7
Width of head	5	4.5
Body	24	23
Fore limb	8.5	8
Hind limb	14	13
Tail	47	44

Loc. Muldiva, North Queensland.

The types will be deposited in the British Museum.

MISCELLANEOUS.

Notes on the Anatomy of Yoldia.—I.

By W. K. BROOKS and GILMAN DREW.

(Abstract of part of a paper reported to the National Academy of Sciences, April 23rd, 1896.)

IN the year 1874 one of the authors published a short paper in the 'Proceedings of the American Association for the Advancement of Science' calling attention to an organ of special sense in the Lamellibranch *Yoldia*. This organ consists of an unpaired tentacle which arises from the mantle near the base of the siphons and is apparently tactile in function.

Since the appearance of this paper many writers on Lamellibranch anatomy have mentioned this organ of special sense, but very little has been added to our knowledge of it. Pelseneer has noted it as occurring on the right side of such specimens of *Leda* as he has examined*, on the left side of his single specimen of *Malletia pallida*, and on either the right or left side (but never paired) in *Yoldia isonota*†.

* "Contribution à l'étude des Lamellibranches," tome xi. Archives de Biologie.

† Report on the Anatomy of Deep-sea Mollusca, Zool. 'Challenger' Exped. pt. lxxiv.

This paper will deal briefly with the position, structure, and nervous connexion of this organ in *Yoldia*.

Two species have been studied—*Y. limatula* and *Y. sapotillo*. Most of the material was obtained through Mr. Richard Rathbun, of the U.S. Fish Commission, and Dr. James L. Kellogg, of Olivet College.

The siphons, long and slender in the adult animal, arise as ridges at the mantle-margin, which ultimately unite in such a manner that two closed tubes are formed. A muscle is developed which serves to retract the siphons, and thus they may be completely withdrawn between the mantle-lobes, although their bases originate at the mantle-margins.

The tentacle under discussion is attached to the point of union of the ventral siphon with the adjacent mantle-lobe, on a level with the ventral border of this siphon, and it lies, when the siphons are retracted, between the mantle-lobe to which it is attached on one side and the walls of the siphons on the other. In both of the species examined the tentacle occurs in about equal proportions on the right and on the left sides, but is apparently never paired. When extended it is a long and slender filament, gradually tapering to its free extremity, and set throughout its length with small somewhat conical papillæ, at the tip of each of which ample magnification shows a cluster of sense-hairs. When retracted it presents a series of transverse wrinkles which tend to obscure these sense-papillæ. Beneath the surface-layer of epithelium run strands of longitudinal muscle-fibres imbedded in connective tissue. On the side nearest the mantle-lobe to which it is attached (right or left, according to its position), and beneath the muscle-layer, is a large nerve which can easily be traced to the tentacle's tip. On the side opposite the nerve, also within the muscle-layer, is a more or less definite space in the connective tissue which is likewise continuous the length of the tentacle. This space, which appears to be a blood-space, is best seen in cross-sections of a somewhat extended tentacle, in which case remnants of a coagulum may be seen in it. Extension of the tentacle seems to be accomplished solely by forcing blood into this space. When the muscles of the tentacle contract, the blood is forced back, and the space may be completely obliterated.

From the posterior end of each visceral ganglion a nerve arises which soon divides. One of these divisions is distributed to the siphons and their retractors, the other to the posterior portion of the mantle-margin. It is from this latter division that the tentacle receives its nerve. In specimens in which the siphons are strongly retracted the base of the nerve which supplies the specialized tentacle is pulled some distance above the tentacle's base. The two nerves, which now lie side by side near the base of the tentacle, form a mass of nervous matter which appears superficially much like a ganglion, and doubtless has been mistaken for one.

The posterior ventral margins of the mantle are fringed with ordinary marginal tentacles which have, beneath the superficial layer of epithelial cells, both longitudinal and transverse strands of

muscle-fibres and generally several blood-spaces. Although I have been unable to trace branches of the pallial nerves into these tentacles, I have traced them to their bases, and there can be little doubt that they are supplied by fibres from these nerves.

If, then, we consider the following points—1st, the specialized tentacle is marginal in formation, and is carried back with the siphons during their development, and more especially by their retraction; 2nd, it is placed sometimes on the right and sometimes on the left side, which may indicate that it is an organ of late specialization, not thoroughly settled in position; and 3rd, it receives its nervous supply as a branch of the same nerve which supplies the marginal tentacles—it may be justifiable to call attention to a possible homology between the specialized tentacle and a marginal tentacle which has become slightly modified in structure and very much enlarged and specialized.—*Johns Hopkins University Circulars*, June 1896, pp. 85, 86.

Some Observations on Spermatogenesis in Spiders.

By JULIUS WAGNER, of St. Petersburg.

My investigations in the course of last year have yielded results which differ so greatly from the observations of Gilson ('*La Cellule*,' t. i.) that I do not consider it superfluous to communicate them, although my studies are not yet completed. The main part of the work was carried out in the Zoological Institute at Heidelberg, and I feel impelled to avail myself of this opportunity of expressing to Hofrath Prof. Bütschli my best thanks for his constant attention and never-failing guidance.

(1) Cell-boundaries between the spermatogones do not exist during the earlier stages. The delimitation of the bodies of the cells takes place at different times according to the species, and in consequence of this the spermatogones of the last generation may be both uni- and multinucleate.

(2) The division of the nuclei of the spermatogones, while not following the ordinary plan of karyokinesis, is nevertheless not amitotic.

(3) In the transformation of the nucleus of the spermatogone into that of the spermatocyte the former network of linin gives rise to a linin-thread or to a few such threads. The nuclei come to assume an excentric position; the whole of the linin passes over with the chromatin granules into one half of the nucleus, namely into that which is adjacent to the periphery of the cell. The linin-thread (or the rows of the chromatin granules) forms loops, all of which are of the same length and have the same direction; in this way the linin-thread divides into portions of equal length. Simultaneously the formation of the nucleolus takes place.

(4) The granules of archoplasm collect in the narrow space which remains between the chromatin half of the nucleus and the surface of the cell. In the interior of the collection of archoplasm thus

produced lies a large lenticular centrosome. After the formation of the sphere of archoplasm a radiation proceeds from it.

(5) After the concentration of the linin and chromatin the membrane of the spermatogone nucleus disappears, and the nuclear fluid mingles with the cytoplasm. The threads of the chromatin granules lie close together.

(6) The nuclei of the spermatocytes are much smaller than those of the spermatogones of the last generation. The membrane of the former is constituted afresh.

(7) After the concentration of the archoplasm the larger portion of the cytoplasm passes over into the same half of the cell, so that the centrosome now lies in the plasmatic portion of the cell.

(8) The number of the centrosomes in the spermatocytes of the first generation is from one to three.

(9) The nucleolus always has an entirely peripheral position; in shape it is elliptical and compressed. The large chromatin granules represent (though not always) from one to two false nucleoli on the opposite side of the nucleus. The true nucleolus never lies in the interior of the linin-thread.

(10) In the division of the centrosome the archoplasm also divides before the nucleus, but immediately afterwards disappears from view.

(11) In the first spermatocyte division the nucleolus divides either in the plane of the equatorial plate, together with the chromosomes, or outside this near one of the poles of the spindle. In the latter case it passes out of the nucleus after the disappearance of the nuclear membrane, but before the completion of the concentration of the chromatin granules (or before the formation of the chromosomes).

(12) The achromatin spindles do not disappear after the first and second division of the spermatocytes. The second achromatin spindle is developed independently of the first. It is possible to isolate the entire achromatin spindle from the cell.

(13) In the division of the spermatocytes cytodieresis is not simultaneous with the division of the nucleus; in certain species of spiders spermatids with four nuclei are first formed.

(14) During cytodieresis the round "intermediate body" ("Zwischenkörperchen") usually arises from the middle portion of the spindle; it may migrate anew into the body of the cell or become constricted off from both daughter cells. The rest of the spindle always remains in the spermatids until their transformation into spermatozoa, forming a round body, which is not constricted off from the spermatozoa until later. These remnants of spindles (and intermediate bodies), which are always found in the testis between the ripe spermatozoa, represent the "granules séminaux."

(15) During the transformation of the spermatids into the spermatozoa the nucleus becomes entirely homogeneous. The whole of the chromatin gradually concentrates upon the nuclear periphery, and the nucleus itself becomes converted into a vesicle. Subsequently the chromatin passes to one side of the nucleus as a

homogeneous plate; the rest of the nucleus disappears, and so all that is left of it finally is this chromatin plate, which elongates and assumes a spiral curve. Simultaneously the "spike" ("Spieß") arises from the achromatin portion of the nucleus.

(16) The spermatozoa possess at certain stages in all species a typical tail with axial filament.

(17) The axial filament is formed in the protoplasm of the spermatocyte (or spermatid) in the first place as a short rodlet, close to which there sometimes lie a few granules of archoplasm. It does not unite with the nucleus until after the transformation of the latter into the chromatin plate.

(18) At the point at which axial filament and chromatin plate unite there lies at the margin of the latter a little tooth-like projection; the proximal end of the filament fits in between this projection and the chromatin plate itself. The portion of the axial filament near the projection is, judging by the readiness with which it takes a stain, a homologue of the end-tubercle in other Arthropods.

(19) The perfectly ripe spermatozoa, which have freed themselves from the remains of the spindle, are mobile (*Tarantula*).

(20) In the passage into the vas deferens the tail of the spermatozoon rolls up and lies upon the nucleus; the nucleus itself doubles up to such an extent that its anterior extremity touches the posterior, whereby it completely surrounds the rolled-up tail. The main portion of the axial filament probably becomes transformed into a homogeneous spherule. Thus in the vas deferens all spermatozoa form rodlet-like or elongate elliptical bodies, among which neither tails nor spikes ("Spiesse") can be distinguished.—*Zoologischer Anzeiger*, xix. Bd., no. 501 (April 27, 1896), pp. 188–190.

Note on *Phascologale flavipes*.

Mr. Edgar R. Waite exhibited a female and eight young of *Phascologale flavipes* obtained in a weathered hole in a sandstone block on the River Hawkesbury. The nest was entirely composed of dried Eucalyptus leaves. It was mentioned that although it is constantly stated that no true pouch exists in members of the *Phascologale*, this is scarcely correct. When very young the offspring are completely hidden by the outer wall of the pouch closing over them. As they increase in size the mouth dilates and no longer conceals the young. Mr. Oldfield Thomas evidently does not admit Krefft's statement that the species mentioned is provided with ten teats. Although eight is the usual number, Mr. Waite had seen several females with ten teats, and there is one in the Australian Museum with twelve and a young one on each teat. It would therefore appear that in *Phascologale* the number of mammae is not a constant character, or three otherwise similar species would have to be admitted, characterized by the possession of eight, ten, and twelve mammae respectively.—*Linn. Soc. New South Wales, Abstract of Proceedings*, July 29, 1896, pp. ii, iii.

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LIII.—*Suggestions for a Natural Classification of the Asconidæ.* By E. A. MINCHIN, M.A., Fellow of Merton College, Oxford.

ALTHOUGH various schemes for classifying the Ascons and grouping them into genera have been proposed at different times, few, except, perhaps, the authors responsible for these systems, would pretend that they any of them represent the true natural affinities of the species amongst themselves. The so-called “*natürliches System*” published by Hæckel in his famous monograph* of the Calcarea, probably the best-known classification of the group, with its seven genera founded exclusively on spicule characters, is a good instance to the point, for here we see, to take a single case, such closely allied forms as *coriacea*, *lacunosa*, and *contorta* separated from one another, and the last-named species placed in a genus together with species so distinct from it as *Lieberkühni* and *complicata*, which, in their turn, are separated from their nearly *botryoides*. Moreover, Hæckel's genera, even had they been absolutely natural, must sooner or later have been renamed, since he put on one side without scruple all the well-known laws of priority with regard to nomenclature which are now as fully recognized by zoologists on the Continent as in England. Exactly the same criticism applies to

* ‘Die Kalkschwämme’ (Berlin, 1872).

von Lendenfeld's classification *, the latest in the field. The obviously unnatural system of Hæckel induced Polejaeff † to place all the species of Ascons together in one genus, and most authors, since the publication of his work on Calcareas, have followed his example; but this is undoubtedly going too far, and such an arrangement can only be regarded as provisional.

Having been engaged for some years now in detailed investigation upon the histology, system, and development of the Ascons, I have been gradually led to recognize certain well-marked and, I believe, natural groups among them. As I hope soon to publish an account of the development of a number of species, it seemed to me best first to make an attempt, perhaps somewhat rash, to fix the nomenclature of at least the commoner and better known species of Ascons in accordance both with their natural affinities and with the laws of priority as regards their generic and specific names. A perfect classification can be obtained, of course, only when all species of Ascons have been studied, and as I cannot claim to have done that, my system is not to be expected to be absolutely complete; but I believe that, so far as it goes, the classification I am now about to put forward is a natural one, and that it indicates the lines upon which Ascons in general will have to be arranged. Since, moreover, the species I have investigated are, for the most part, just those which have been longest known and earliest described, it is by them that the generic nomenclature of the group as a whole must be determined. I hope to make up for the shortcomings of the present memoir in a subsequent work, where I shall treat the subject more fully and extend my classification to all known Ascons.

Before proceeding further, however, I must first protest against a notion which has been prevalent since Hæckel's writings, and due largely to them, namely that the form of an Ascon colony is useless for purposes of generic or specific determination. It cannot be denied that many classifications, based upon external form, have been tried and found wanting; but this seems to me to be due to two causes—first, that the individuals selected were often such as had not yet attained their full growth and characteristic form, and, secondly, that the very great changes in appearance due to contractility were overlooked. Both these propositions may be illustrated from

* "Die Spongien der Adria," Zeitschr. f. wiss. Zool. liii. (1891) pp. 185–321 and pp. 361–433, Taf. viii.–xv.

† "Report on the Calcareas," 'Challenger' Reports, Zoology, vol. viii. part 2.

the system given by Hæckel in his "Prodomus eines Systems der Kalkschwämme"*, where the principle of classification by external characters was carried to its furthest logical conclusion. Many of the genera were based simply upon young forms, such as *Olynthus* and *Olynthium*. The species *blanca* is a good illustration of this. Miklucho-Maclay †, in his description of this species, gave admirable figures to show the changes of form passed through in the growth of the young "*Olynthus*" into the reticulate mass formed by the large colonies; yet this species figures under no less than four genera, and might easily have figured under more still. It might be urged that, since Hæckel himself fully recognized the artificial nature of his classification, it is hardly fair to subject it to criticism; but, on the other hand, it might be replied that it is hardly fair to push a principle to an absolutely ridiculous extent and then point to the result as a proof of the badness of the principle in question. Contracted and partly contracted forms, again, play an even larger part in the classifications not only of Hæckel but of others also. No one, I think, will now dispute the statement that Hæckel's genus *Prosycom* was founded on individuals with closed pores, and his genera *Clistolynthus*, *Sycorrhiza*, *Auloplegma*, &c. on specimens with closed oscula. But the height of absurdity is reached when we find a whole order of calcareous sponges, *Metrosyca*, with two families and several genera, founded by Hæckel on specimens in which different parts of the colony were in different states of contraction. Similarly I was able to show ‡ that Hæckel's different varieties of *Ascetta clathrus* were based on specimens in different degrees of contraction, and that the form which he named *Ascetta mirabilis*, in order to express his astonishment at finding two varieties united in one specimen, was simply a colony which was in parts more, in parts less, contracted. Yet it is this form which Polejaeff § regards as proving that the guidance of external differences in classification is very uncertain. It was on contracted specimens of *clathrus*, or perhaps of *coriacea*, that Gray founded his genus *Clathrina*, a genus which nevertheless, as I shall try to show, the laws of priority oblige us to retain. Contractility is so marked a feature of a large section of the Ascons that its being overlooked almost entirely by Hæckel, and by many others who came both before and after him, is

* Jen. Zeitschr. v. (1870) pp. 236-254.

† "Beiträge zur Kenntniss der Spongien, I.," Jen. Zeitschr. iv. (1868) pp. 221-232, Taf. iv., v.

‡ Quart. Journ. Micr. Sci. n. s. xxiii. p. 490.

§ *Loc. cit.* p. 4.

a proof to my mind that their acquaintance with Ascons must have been practically limited to preserved specimens.

It is my experience, on the contrary, that almost any species of Ascon can be identified at sight when one is acquainted with it, especially when it is living healthily or when preserved in a healthy and expanded condition—a state of things not always found even in many specimens of Ascons sent out by great zoological stations—and that the mode of growth of the colony is a character of great generic value. It is true that it is almost hopeless to recognize an Ascon by its exterior from the figures given by Hæckel, but that is hardly the fault of the Ascons. Indeed, it is not too much to say that the “Habitusbilder” given by Hæckel, though no doubt of great artistic merit, are practically useless for scientific purposes.

Apart from the interesting species *falcata*, Hæckel, I recognize two main groups in the Ascons, which, perhaps, at a later and more advanced stage of zoological science, will attain to the rank of families or subfamilies, but which at present must rank as genera*. In the first group are such forms as *coriacea*, Mont., *lacunosa*, Johnston, *reticulum*, O. S., *clathrus*, O. S., *contorta*, Bwk., *blanca*, M. M., *primordialis*, H., *cerebrum*, H., and *spinosa*, Lend. In the second group are *botryoides*, Ell. & Sol., *complicata*, Mont., *Lieberkühni*, O. S., and *variabilis*, H.

In the first group, of which *coriacea* may be taken as the type, the full-grown colony always has a reticulate form, and the osculum has the value of a cloaca or vent. The form typically assumed by members of this genus is that of a dense reticulum of ramifying and anastomosing tubes, which are usually of smaller diameter at the base and outskirts of the colony, and gradually become enlarged as they approach the osculum. Sometimes, as in the encrusting “leathery” forms of *coriacea*, the tubes form a simple network in one plane, from which the oscula rise perpendicularly. Sometimes the point of attachment of the colony is drawn out into a single long stalk, as in *lacunosa*, into one or several stalks, as in *blanca*. The osculum may be very inconspicuous, or it may be of relatively great diameter, forming a central basin with raised edges, into which a system of tubes empties itself; or, again, it may be narrow and elevated, shaped like a chimney,

* It may become possible later to subdivide these groups on characters of canal-system and so forth. Thus, in the group I have called below by the generic name *Clathrina*, Gray, the two species *cerebrum* and *reticulum* seem to differ in some details from the other species of the genus.

and scarcely or not at all wider than the surrounding tubes; but in any case it has distinctly the appearance of a mere exhalant opening for the system of tubes of which it is the central point. The Ascons of this group correspond very nearly to Hæckel's families Tarromida and Nardopsida.

In the second group, of which *botryoides* is the type species, the osculum is large in comparison with the network of tubes, which it completely dominates. The tubes, often very minute, as in *botryoides* itself, form a basal or subbasal network, from which arise the erect oscula, the latter having much more the appearance of individuals than of simple cloacæ. The oscula grow in height and send out radial diverticula, sometimes over their whole surface, which continue to grow and become ramified, forming branches which either may themselves become new oscular tubes, giving rise to an arborescent colony, or may anastomose to form a network of tubes, from which new oscula in their turn arise. Thus the adult colony consists usually of two parts—a fine network of tubes, from which arise at intervals the erect oscula, often of great size. This mode of growth is liable to considerable variation, from the grape-like cluster of oscula presented by *botryoides* on the one hand to the arborescent “*pinus*” * form of *complicata* on the other; but the adult colonies of this group can never be confused with the reticulate masses formed by the *coriacea* type.

These differences of form and growth, so hard to describe accurately but so easy to recognize, are shown to be of generic value by the fact that they occur correlated with a great number of other characters—structural, histological, and embryological—of which I can only mention here the most salient.

In the first or *coriacea* group the principal skeletal spicules are equiangular triradiates, some or even the majority of which may become quadriradiate by the addition of a fourth or gastral ray, but without the three basal rays (or, as we may conveniently term them, the *triradiate systems*†) losing

* Hæckel's figure of “*Ascandra pinus*” gives quite a false notion of this form, for it does not really stand erect and foursquare to all the winds that blow, as his figure would lead one to believe, but it is a creeping form, attached at numerous points to the algæ &c. among which it grows. The oscular tubes only become erect to any considerable degree when it grows in dense clumps, such as are not uncommon in deep water off the Mewstone at Plymouth.

† I shall use the phrase “triradiate systems” in this paper to denote the triradiate spicules or the basal rays of the quadriradiates. While in the quadriradiates the basal rays are formed exactly in the same manner as the triradiates, the fourth or gastral ray has a distinct origin and appears later.

thereby their equiangular character. The triradiate systems may become bilateral in form by alterations in the length of a ray relatively to the other two, but never, except abnormally, by changes in the angles at which they meet, at least in the case of the principal spicules of which the general skeleton is composed, and which are found in all parts of the sponge. In other words, the triradiate systems may become "ungleichstrahlilig," but never "ungleichwinkelig." When triradiate systems with paired angles occur, sagittal triradiates as Hückel has well termed them, they form a special dermal or other layer restricted to some region of the sponge colony. Monaxons may be present in addition to tri- and quadriradiates. All the species of this group are very contractile and have a well-developed contractile flat epithelium distinct from the skeletogenous layer. In the forms without quadriradiate spicules the contraction may reach a pitch at which the tubes become solid. In those with quadriradiates the projecting gastral rays exercise a hindrance to the contraction of the tubes in proportion to the length of the rays, and contraction is not possible to the same extent as in the "Ascetta" forms, but it is still very marked. In the histology we may notice, as a striking and very constant character, that in the collar-cell the nucleus is situated at the base of the cell. In the embryology the larva is a *parenchymella**—that is to say, a ciliated blastula in which cells migrate inwards to form an inner mass or future dermal layer, which is completely covered by the ciliated or gastral layer. Finally, we may note that the first spicules to appear after fixation are triradiate systems, so that the young sponge passes through what may be called a "Protascetta" stage†.

In the *botryoides* group, on the other hand, the principal triradiate systems of the skeleton are sagittal, having become bilaterally symmetrical through the basal rays meeting in such a way as to form an unpaired and two paired angles. So far as I know, equiangular triradiate systems never occur among the spicules of this group. The sponges of this genus are in contrast with those of the preceding through their non-contractility, due apparently to the fact that the cells of

* Using this term in a descriptive sense only, without wishing to imply any homologies of the component layers.

† I have found the *parenchymella* larva and the *Protascetta* stage in *coriacea*, *blanca*, *cerebrum*, *reticulatum*, and *contorta*. In the last-named Barrois has described and figured an amphiblastula larva ("Mémoires sur l'embryologie de quelques Éponges de la Manche," Ann. d. Sci. nat. (6) iii. 1876, pp. 35-37, pl. xiv. figs. 21, 22), but this statement must rest on an error of identification. *Parenchymella* larvæ have also been described in *clathrus* and *primordialis* by Metschnikoff and Schmidt.

the superficial flat epithelium secrete the monaxon spicules with which the surface always bristles, and have given up or have not acquired the contractile function. My histological studies are not yet sufficiently advanced to enable me to state this as a general proposition for the whole group; but in the young specimens, bred from the larva of *variabilis*, I found very clearly that each cell of the flat epithelium secretes a single monaxon spicule, and I believe the same to be true of the adults also. In the histology the collar-cells have the nucleus in the upper part of the cell close under the collar*. The larva, so far as it has been observed, is an amphiblastula†, the dermal cells not being covered by the gastral layer, and the first spicules to appear in the development are monaxons, so that the sponge passes through what may be termed a "Protascyssa" stage.

Finally, there remains for consideration the interesting *Ascandra falcata*, H. This Ascon is remarkable for the fact that the interior of the gastral cavity is thrown into folds, forming radial tubes like a *Sycon*, though it should be noted that these diverticula are not foldings of the whole body-wall of the sponge, as in a *Sycon*, but of the inner layer alone. The colony has the form of a loose reticulum of tubes, from which arise at intervals the chimney-like oscula, whose diameter is scarcely greater than that of the tubes. Thus in form it more approaches the *coriacea* rather than the *botryoides* group, and in all other important points of structure, histology, and development it also belongs to the former group. The triradiate systems are equiangular, there is a well-marked contractile epithelium distinct from the skeletogenous layer, the collar-cells have the nucleus at the base, the larva is a parenchymella‡, and the first spicules to appear are tri-radiates. In fact, the only character which separates this species at all sharply from the *coriacea* group is furnished by the folds of the gastral epithelium. Admitting this to be a character which is sufficient to permit of separating *falcata*

* The collar-cells of individuals of this group are often to be found remarkably shortened, almost flattened, so that the height of the cell is scarcely greater than the diameter of the nucleus. In such cases it is, of course, impossible to say if the nucleus is basal or terminal in position. Where, however, the cell has its normal more or less columnar form, the nucleus is always distinctly terminal. The figures given by Bidder of the collar-cells of *Sycon compressum* &c. serve admirably to illustrate this point (Quart. Journ. Micr. Sci. n. s. vol. xxxviii. pl. ii.).

† Seen in *Lieberkühni* (Keller) and *variabilis*.

‡ I found the larva at Banyuls-sur-Mer in July of this year. It closely resembles the larvæ of *blanca* and *contorta*, scarcely differing from the latter except in size and shape.

from *coriacea* and its allies, we find ourselves confronted with three generic groups amongst the Ascons. The question at once arises, What are these three genera to be called? To decide the problem of their proper nomenclature we must shortly review the systematic history of the Ascons, noting the generic names that have been proposed in chronological order.

In 1786 Ellis and Solander * described the first-known Ascon under the name of *Spongia botryoides*.

In 1812 Montagu † described two more species—*Spongia complicata* and *S. coriacea*.

In 1828 Fleming ‡ instituted the genus *Grantia* for calcareous sponges, the first species being *G. compressa*, Fabr., the second *G. botryoides*, under which he wrongly placed *complicata* as a synonym.

(At slightly later dates the names *Leucalia* and *Calci-spongia* were proposed by Grant and de Blainville respectively in the same sense as *Grantia*, but never obtained a place in the literature.)

In 1862 Schmidt § described two new species (*Grantia Lieberkühnii* and *G. pulchra*) and instituted a new genus (*Nardoa*) for a third new species (*Nardoa reticulum*). But the name *Nardoa* had been used by Gray in 1840 for a genus of Asteroidea, and cannot therefore be employed for calcareous sponges.

In 1864 Bowerbank || founded a new genus for Ascons—*Leucosolenia*—with *L. botryoides*, Ellis, as typespecies, *Grantia* being used for Sycons, with type *G. compressa*, Fabr.

In the same year O. Schmidt ¶ described "*Grantia clathrus*," sp. n.

In 1866 Bowerbank ** enumerated four species of his genus *Leucosolenia*—*L. botryoides*, *L. contorta*, sp. n., *L. lacunosa*, and *L. coriacea*.

In the same year Schmidt †† published a criticism of Bower-

* 'The Natural History of many curious and uncommon Zoophytes' (London), p. 190, tab. lviii. figs. 1-4.

† "An Essay on Sponges &c.," Mem. Wernerian Nat. Hist. Soc. vol. ii. pp. 89 et seq., pl. ix. figs. 2, 3.

‡ 'A History of British Animals' (Edinburgh, 1828), p. 525.

§ 'Die Spongien des adriatischen Meeres' (Leipzig, 1862), pp. 13-19, Taf. i. figs. 8-8b.

|| 'A Monograph of the British Spongiadæ,' vol. i. (Ray Society), p. 164, figs. 347, 348.

¶ 'Spongien des adriatischen Meeres,' I. Supplement (Leipzig, 1864), p. 24, Taf. iii. figs. 3, 3a.

** *Op. cit.* vol. ii. pp. 28-36.

†† *Op. cit.* II. Supplement, pp. 7, 8.

bank's genera and species of sponges. He retained the name *Leucosolenia* for "*Grantia botryoides* und ähnliche," while for the "massive Grantien" he maintains his own genus *Nardoa*. Thus he classifies the Ascons known to him as follows:—*Leucosolenia botryoides* and *pulchra**, *Nardoa lacunosa*, *reticulum*, and *spongiosa**, Kölliker.

In 1867 Gray† published a classification of calcareous sponges in which the Ascons were distributed among two genera:—(1) *Leucosolenia*, which was further divided into "arborescent" forms, as *L. botryoides*, "massive, *Nardoa*," as *L. contorta* and *L. lacunosa*, and "incrusting," as *L. coriacea*; (2) *Clathrina*, gen. nov., for *C. sulphurea*=*Grantia clathrus*, O. S. Had the author known *coriacea* in its "massive" forms and *clathrus* in its expanded condition, there can be no doubt he would have put them in his *Nardoa* group, and then his classification would have been practically the same as the one I propose here.

In 1868 Miklucho-Maclay‡ described a new genus and species of Ascons—*Guancha blanca*.

In 1870 appeared Hückel's confused and perplexing 'Prodromus' §, which, after what has been said above, need not detain us longer; and in 1872 he put forth|| his well-known "natural system," in which the sponges we are here concerned with appeared under generic names as follows:—

- (1) *Ascetta coriacea*, *blanca*, *clathrus*, and *primordialis*, sp. n.
- (2) *Ascortis lacunosa*.
- (3) *Ascaltis botryoides* and *cerebrum*, sp. n.
- (4) *Ascandra Lieberkühnii*, *contorta*, *complicata*, *variabilis*, sp. n., and *falcata*, sp. n.

In 1883 Polejæff¶ united all Ascons in Bowerbank's old genus *Leucosolenia*.

In 1891 von Lendenfeld** tried to improve on Hückel's scheme, with the following result:—

* *Pulchra*, O. S., and *spongiosa*, Kölliker, are doubtful species. The former is asserted by von Lendenfeld to be a synonym of *primordialis*, and *spongiosa* is doubtfully identified by Hückel as *cerebrum*. It seems to me not improbable that *pulchra*, and perhaps *spongiosa* also, are synonyms of *coriacea*.

† "Notes on the Arrangement of Sponges, with the Description of some new Genera," Proc. Zool. Soc. 1867, pp. 553–558.

‡ "Beiträge zur Kenntniss der Spongien," Jen. Zeitschr. iv. pp. 221–232, Taf. iv., v.

§ *T. c. suprâ*.

¶ *Loc. cit.*

|| *T. c. suprâ*.

** *Loc. cit.*

- (1) *Ascetta primordialis*, *spinosa*, sp. n., *cerebrum*, *clathrus*, *blanca*, and *Gæthei*.
- (2) *Ascandra reticulum*, *Lieberkühni*, and *angulata*, sp. n., = *lacunosa*, Johnston.
- (3) *Homandra*, gen. nov., for *H. falcata*, H.

Other recent writers have followed, sometimes one, sometimes another of these many and various schemes of classification, though the majority incline to follow Polejaeff.

From the above summary it seems clear that—

(1) *Leucosolenia*, with type species *botryoides*, is the generic name which belongs to the second of my groups.

(2) The first of my groups, the group to which I have generally referred as the *coriacea* group, would claim as generic title the name *Nardoa* of Schmidt, with *reticulum* as type species, were not this name preoccupied in another class of the animal kingdom, and therefore inadmissible. The first of the names by which any member of this group was afterwards described must therefore be taken instead of *Nardoa*, which gives as generic name *Clathrina*, Gray, type species *C. clathrus*, O. S.

(3) *Falcata* was first described as *Ascandra falcata*, H. Since all other species of Hæckel's genus *Ascandra* are to be distributed among the genera *Clathrina* and *Leucosolenia*, it remains alone in the genus *, and therefore claims the name. Should any other species of *Ascandra* prove to have a prior claim to the name, then Lendenfeld's name *Homandra* would have to be used.

Hence my classification of the Ascons will run as follows:—

I. Genus CLATHRINA, Gray, 1867, emend.

The full-grown colony forms a system or systems of reticulate and anastomosing tubes, each system terminating in a cloaca-like osculum; incrusting, massive, or stalked. The principal spicules of the skeleton are equiangular triradiate systems, to which may be added sagittal triradiates in certain parts of the sponge, and monaxons. Collar-cells with nucleus at the base.

* Of the other species enumerated by Hæckel in his genus *Ascandra*, the species *cordata*, *densa*, and *panis* appear to be true *Clathrinas*, and the species *echinoides*, *sertularia*, *botrys*, *nitida*, and *pinus* are *Leucosolenias*. From the examination of type specimens in the collection of the Rev. A. M. Norman and elsewhere, types which were used by Hæckel for the preparation of his monograph, and named by him, I have the clearest evidence that *botrys*, and probably also *nitida*, are synonyms of *botryoides*, and *pinus* of *complicata*. It is probable that careful examination will prove many other of Hæckel's species to be equally unfounded.

To these diagnostic points we may add, as constant characters, so far as has been observed:—

Larva a parenchymella. First spicules to appear triradiate systems.

1. *Clathrina clathrus* (type species).
Grantia clathrus, Schmidt, 1864.
2. *Clathrina coriacea*.
Spongia coriacea, Montagu, 1812.
3. *Clathrina lacunosa*.
Grantia lacunosa, Johnston, 1842.
Syn.: *Ascandra angulata*, Lendenfeld, 1891.
4. *Clathrina reticulum*.
Nardoa reticulum, Schmidt, 1862.
5. *Clathrina contorta*.
Leucosolenia contorta, Bowerbank, 1866.
6. *Clathrina blanca*.
Guancho blanca, Miklucho-Maclay, 1868.
7. *Clathrina primordialis*.
Ascetta primordialis, Hæckel, 1872.
8. *Clathrina cerebrum*.
Ascartis cerebrum, Hæckel, 1872.
9. *Clathrina spinosa*.
Ascetta spinosa, Lendenfeld, 1891.

II. Genus LEUCOSOLENIA, Bowerbank, 1864.

The adult colony has the form of a cluster of relatively large erect oscular tubes, which send out numerous diverticula and are often arborescent, united typically by a more or less stolon-like system of finer tubes. Tirradiate systems always sagittal. Collar-cells with nucleus at apex, close under the collar.

To this may be added, as probably constant characters:—

Larva an amphiblastula. First spicules to appear monaxons.

1. *Leucosolenia botryoides* (type species).
Spongia botryoides, Ellis and Solander, 1786.
Syn.: *Ascandra botrys*, Hæckel, 1872.
? *Ascandra nitida*, Hæckel, 1872.
2. *Leucosolenia complicata*.
Spongia complicata, Montagu, 1812.
Syn.: *Ascandra pinus*, Hæckel, 1872.
3. *Leucosolenia Lieberkühnii*.
Grantia Lieberkühnii, Schmidt, 1862.
4. *Leucosolenia variabilis*.
Ascandra variabilis, Hæckel, 1872.
Syn.: *Leuconia Somesii*, Bowerbank, 1874*.

* I have been able to examine in the British Museum the three specimens of "*Leuconia Somesii*" figured by Bowerbank on plate xci. figs. 6-8 of vol. iii. of his 'Monograph of the British Spongiada' (Ray Society, 1874). They are simply specimens of *Leucosolenia variabilis* in which the monaxons attain a great development, and their label bears on it, in

III. Genus ASCANDRA, Häckel, 1872, emend.

The full-grown colony has the form of a loose reticulum of tubes with numerous erect chimney-like oscula. The gastral layer thrown into folds, forming radial diverticula. All other characters as in *Clathrina*.

With one species:

Ascandra falcata, Häckel, 1872.

There remain many other known species of Ascons, as, for instance, the interesting forms from Australia described by Carter and Dendy, to which this classification must be fitted, either in its present or in a modified form, if it is to be rendered complete; but, as I have already said above, I defer for the present any discussion as to their place in my system, handling here only those species with which I am familiar in the flesh. But the two interesting species which Häckel has described in his genus *Ascyssa* deserve a few passing remarks. They are peculiar for the fact that the skeleton consists only of monaxon spicules, thus reminding us of the stage which is transitory in *Leucosolenia variabilis*, and also, as Metschnikoff first pointed out, in *Sycon*.

It is remarkable that no naturalist since Häckel's time appears to have met with these sponges, a peculiarity which they share with many other striking forms of animal life discovered by Häckel. Considering the precise locality given by Häckel in the case of *Ascyssa troglodytes*, "on colonies . . . of *Astroides calycularis* . . . in the Blue Grotto of the Island of Capri . . . and in other caves of the island," and, further, his description of it as "small, delicate, brown tubes, which were seated, some singly, some together in clumps, on dead colonies of *Astroides*," it is astonishing that it should not have been found, so far as I am aware, up to the present by the energetic naturalists of the Zoological Station at Naples.

Carter's handwriting, the name "*Soleniscus variabilis*, II." The monaxons vary from minute to those of very large size, and the first specimen—fig. 6 of Bowerbank—is further remarkable for the great number of irregular triradiate spicules it contains. In fact, it might be said of this specimen that abnormality has become the rule, and regularity the exception, in respect to its triradiate spicules, and it appears to be from this specimen that Bowerbank took his figures of the spicules. Nevertheless enough regular triradiate systems can be found to characterize the sponge beyond all doubt, and the other two specimens are perfectly normal colonies of *variabilis*. In view of the fact that these specimens came originally from the Brighton Aquarium, it would be interesting to see how far the peculiarities of spiculation are due to life in the aquarium. Compare Bidder's account of "*Sycon raphanus*, var. *aquariensis*, nova," from the Naples Aquarium (Quart. Journ. Micr. Sci. n. s. xxxviii. p. 10).

Nevertheless it does not seem to me improbable that these forms should exist, and their relations to other Ascons would certainly prove of great interest. They probably occupy somewhat the same relation to the species of the genus *Leucosolenia* that the *Ascetta* forms of the genus *Clathrina* occupy to the remaining species: but in one respect they are probably much more primitive than any other Ascons; for if the monaxon spicules composing the skeleton are, like those of the young *variabilis*, secreted each by a cell of the flat external epithelium, then, since the layer of triradiate systems is absent, there should be no cells between the flat epithelium and the gastral collar-cell layer, except the wandering and genital cells—in other words, the so-called mesoderm might be expected to be practically entirely absent, and, if so, the two species of *Ascyssa* would be more primitive in structure than any other known Ascons.

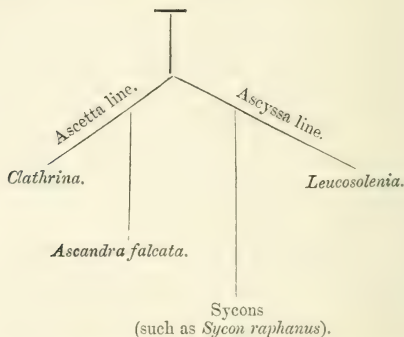
To predict is always dangerous; but I venture to believe that these *Ascyssa* species, if they exist, will prove on investigation to be on the *Leucosolenia* stem, so to speak, and will be found to have collar-cells with the nucleus in the upper portion and an amphiblastula larva, or, at least, a larva more resembling the amphiblastula than the parenchymella. Hæckel's figure of *Ascyssa acufera*, it may be noticed, shows a typical arborescent *Leucosolenia*-like colony*.

Ascandra falcata is an interesting form which has often been regarded as intermediate to a great extent between Ascons and Sycons. But this does not seem to be true, at least if we take as typical of the Sycons such a form as *Sycon raphanus*; for while *Ascandra falcata* is shown, by all its characters, to be distinctly on the *Clathrina* stem, *Sycon raphanus*, on the other hand, is plainly allied to the genus *Leucosolenia*; it is distinguished from the latter only by its form and mode of growth and by the restriction of the collar-cells to the radial tubes; but in all other characters it agrees with it, namely in the sagittal spicules, the collar-cells with terminal nucleus, the amphiblastula larva, and the transitory *Ascyssa* stage in the development. Bidder† has well pointed out the importance of the arrangement of the spicules in the radial diverticula of the oscular tubes of *Leucosolenia Lieberkühnii*, an arrangement which shows plainly that in these diverticula the current is at first centripetal, so that they are strictly comparable, as long as they have not exceeded a certain length, to the radial tubes of a Sycon. The number

* Hæckel, 'Die Kalkschwämme,' Taf. vii. fig. 4.

† "Review of Dendy's 'Monograph of the Victorian Sponges,'" Quart. Journ. Micr. Sci. n. s. xxxii. (1891) p. 627.

of characters in which *Leucosolenia* approaches *Sycon* seem to me indubitable proof of their genetic relationship, just as the characters of *Ascandra falcata* show it to be on quite a different line. The relations of the genera can best be indicated by the graphic method as a genealogical tree:—



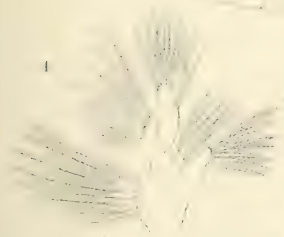
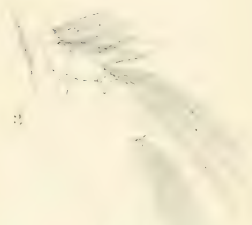
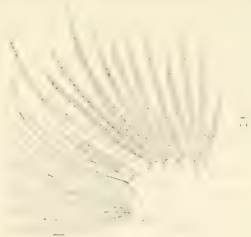
It seems to me an open question, however, whether there may not be amongst the Heterocœla—Sycons or Leucons—forms which are on the Ascetta line and which approach *Clathrina* or *Ascandra* in the same way that *Sycon raphanus* approaches *Leucosolenia*.

Oxford,
October 1896.

LIV.—On *Scolecithrix hibernica*, a new Species of Copepod, with some Remarks on the Distribution of the Crustacea. By ANDREW SCOTT, Fisheries Assistant, University College, Liverpool.

[Plates XVII. & XVIII.]

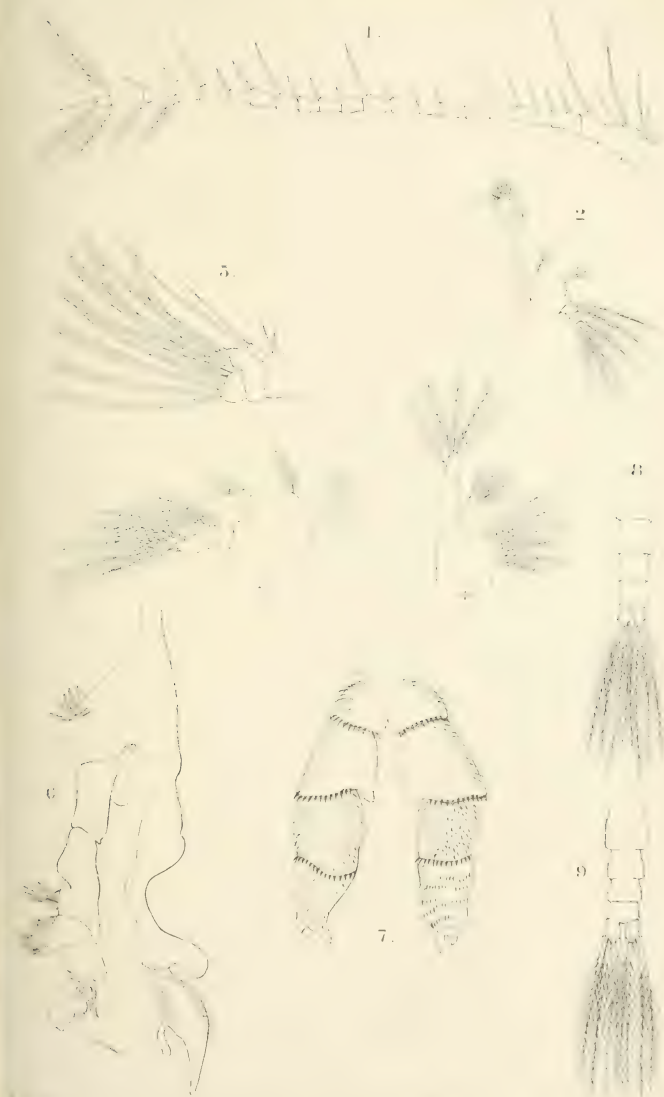
Description of the Species.—*Female*. Length, exclusive of caudal setæ, 1.2 millim. ($\frac{1}{20}$ inch). Body moderately robust; cephalothoracic segment large, nearly as long as the combined lengths of the remaining body-segments and abdomen; last segment of the body produced laterally on each side into spine-like processes. Antennules of moderate length, slender,



Accur. del. ad nat.

SCOLECITHRIX HIBERNICA n.sp.

Minton Bros. lith.



del. ad. nat.

SCOLECITHRIX HIBERNICA. n. sp.

Mintern Bros. lith.

reaching to near the end of the body, and composed of four joints, the proportional lengths of which are shown by the formula—

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
12	10	6	6	5	5	6	10	6	6	7	7	7	7	7	7	8	8	8	6	9	10	4		

The joints are only sparingly setiferous, but the twenty-first and twenty-second have each one plumose seta on the distal end of the lower margin; the twenty-third bears two plumose setae at the distal end—one on the lower and one on the upper margin—while the twenty-fourth joint is furnished with two plumose and two plain apical setae; two short sensory filaments—one a little longer than the other—spring from the distal end of the upper margin of the second joint. Primary branches of the antennae very short, two-jointed; secondary branches fully three times the length of the primary ones and composed of six joints, the third, fourth, and fifth joints being very short; both branches are furnished with a number of plumose setae. Mandibles fairly well developed, the biting-part armed with a number of small teeth; palp small, two-branched, the upper branch very small and composed of two joints, the lower considerably larger and apparently four-jointed. Maxillae well developed and somewhat similar to those of *S. dane*; the foot-jaws also resemble those of that species. The inner branches of the first pair of feet are one-jointed, of the second two-jointed, of the third and fourth three-jointed, while the outer branches of all the four pairs are three-jointed. The female has no fifth pair of feet. Abdomen four-jointed; genital segment as long as the combined lengths of the second and third joints; second, third, and fourth joints of about equal length. Caudal stylets slightly longer than the last abdominal segment, length about equal to twice the breadth.

Male. Somewhat similar to the female, except in the following points:—The proportional lengths of the joints of the antennules differ slightly, as shown by the formula—

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
8	8	7	4	4	4	5	8	7	6	6	7	7	6	6	6	7	6	8	6	9	9	4	

The mandibles are very small and somewhat rudimentary; the biting-part has apparently no teeth, but consists of an evenly rounded edge; the mandible-palp has the basal part larger than that of the female; the uppermost of the two branches is small and two-jointed, but the lower one is large and composed of three joints. The maxillae are also very small and somewhat rudimentary. The anterior foot-jaws

shed with fewer setæ, but bear a larger number of "an-hairs" than those of the female. The fifth feet are developed and form a powerful grasping-organ; they consist of a large basal part armed with a comb-like row of spines on its left surface and furnished distally with two elongate branches of nearly equal length and of a somewhat complicated structure; the right branch is composed of two joints, the first of which is long and of an irregular outline; the second is considerably smaller and terminates in a finger-and-thumb-like arrangement; the left branch is apparently four-jointed; the second joint, which is slightly longer than the first, is furnished on its outer distal margin with a number of spine-like processes arranged in three tufts; the third and fourth joints are small, the fourth joint, which ends somewhat abruptly, being furnished on its inner margin with one moderately long and two short spines, and also with a few short spines on its surface. The drawing (Pl. XVIII. fig. 7) shows the fifth feet of an immature male; they differ considerably from those of the mature form, as is frequently the case among the Calanidæ. Abdomen apparently five-jointed; first, second, third, and fourth joints subequal in length, fifth very small. Caudal stylets scarcely so long as the fourth segment; length about equal to twice the breadth.

Habitat. In deep water off the County Down coast, between Dundrum and Dundalk Bays, Ireland; common. Also in deep water in upper Loch Fyne and off the coast of Arran, Scotland.

Remarks. This species first became known to me from specimens found in material collected in a tow-net attached to the beam of a fish-trawl and worked close to the bottom of the sea. The material was obtained by Mr. R. L. Ascroft, one of the members of the Lancashire Sea-Fisheries Committee, when on board a trawler that was fishing in deep water (21 to 29 fathoms) in the Irish Sea between the Isle of Man and Ireland in the beginning of February last. Some time afterwards my father, Mr. T. Scott, F.L.S., sent me specimens of a *Scolecithrix* which he had obtained in bottom tow-net material collected in upper Loch Fyne and in the Firth of Clyde in April last; these, on examination, proved to be identical with those from the Irish Sea, and, as all the specimens observed have been obtained in water of considerable depth and where the bottom consists of mud, this would seem to indicate that it is really a deep-water species, and may, perhaps, also explain why it has been so long overlooked.

Scolecithrix hibernica has been carefully compared with

the described species of the genus, to ascertain if it could be assigned to any of them ; but it seems to be clearly distinct, and I now describe it as new under the name given.

The occurrence of a representative of *Scolecithrix* in the British seas is of some interest from its bearing on geographical distribution, showing that it is by no means confined to the warmer waters of the globe, and that it is evidently widely distributed. This genus was first described by Professor Brady in his Report on the Copepoda collected during the Voyage of the ' Challenger.'

Recent researches among the Crustacea have brought to light a considerable number of new species, besides adding British stations for species that have been described by continental workers ; on the other hand, not a few of the species described by British authors have been discovered in foreign waters.

In a paper "On Free-swimming Copepoda from the West Coast of Ireland," lately published by Mr. I. C. Thompson, F.L.S.*, one of the most successful students of the Copepoda in recent years, he records *Corycæus speciosus*, Dana, for the first time from British waters, and suggests that it may have been carried to the British coasts by the Gulf-stream. That the Gulf-stream has some influence in bringing Copepoda and other Crustacea to our shores whose true habitat is in the warmer waters of the globe, and in enabling them to survive amid the colder waters round our shores, is not doubted. It is a well-known fact that, from some cause not clearly understood, shoals of Crustacea sometimes make their appearance in the waters round our coasts ; and a few years ago the north-east coast of England was visited by such numbers of a species of Amphipod (*Euthemisto compressa*, Goes) that the beach in the neighbourhood of Redcar was covered with them. Professor M'Intosh has also recorded the occurrence of *Boreophausia* in immense numbers in St. Andrews Bay within recent years. But, notwithstanding these facts, the explanation suggested by Mr. Thompson, though it may account for some of the additions that have been made to the British Copepod fauna, is scarcely sufficient to explain the occurrence in the British seas of several even of the so-called pelagic Copepods that have been described by foreign authors. Probably a more satisfactory explanation may be arrived at if we consider the amount of work that has been done amongst the marine fauna in connexion with the fisheries investigations carried on during recent years and the attention

* Trans. Liverpool Biol. Soc. vol. x. p. 95.

that has been bestowed upon fish-food, of which Crustacea form a not inconsiderable part; for it is owing very much to these investigations that the majority of the additions to the marine and freshwater fauna of our island have been made. Amongst the marine Copepoda there is one species (*Euchaeta norvegica*) which is often found in myriads in tow-net material collected in the deeper waters of Loch Fyne. From a single haul made with the mid-water net of the 'Garland' in April of this year sufficient *Euchaeta* were obtained to more than fill a large drop-jar, such as may be seen in confectioners' windows, and yet its discovery is only of comparatively recent date, no record of it appearing in Prof. Brady's valuable monograph on the British Copepoda; and this species is certainly not a casual visitor. Further, Dr. John Murray some years ago discovered in Loch Etive an Ostracod (*Conchæcia elegans*, G. O. Sars) which had not been known to exist within the British area, and this Ostracod can still be obtained in abundance in the place where it was first discovered, showing that it also is not a casual visitor. Other examples could be given if necessary.

The occurrence of so many additions to our crustacean fauna is due, as has already been said, to the recent more or less systematic prosecution of fishery investigations, and probably also to greater care being taken in the discrimination of species. The enjoyment of greater facilities for collecting material and the adoption of improved methods in its examination have also doubtless tended to enlarge our knowledge of the Crustacea, and especially of the more minute species; and it is to causes such as these, rather than to the influence of the Gulf-stream or other currents, that the discovery of most of the new and interesting species that have been recently added to the British fauna is to be ascribed.

It is also noteworthy that many of the species of Copepoda described within recent years by British students are being found at continental stations and recognized by foreign authors as good species.

EXPLANATION OF THE PLATES.

PLATE XVII.

- Fig. 1.* Female, seen from the left side. $\times 100$.
- Fig. 2.* Antennule, female. $\times 95$.
- Fig. 3.* Antenna. $\times 127$.
- Fig. 4.* Maxilla, female. $\times 190$.
- Fig. 5.* Anterior foot-jaw. $\times 190$.
- Fig. 6.* Posterior foot-jaw. $\times 190$.
- Fig. 7.* Foot of first pair of swimming-feet. $\times 154$.
- Fig. 8.* Foot of second pair of swimming-feet. $\times 154$.
- Fig. 9.* Foot of fourth pair of swimming-feet. $\times 154$.

PLATE XVIII.

- Fig. 1. Antennule, male. $\times 126$.
 Fig. 2. Mandible and palp, female. $\times 127$.
 Fig. 3. Mandible and palp, male. $\times 253$.
 Fig. 4. Maxilla, male. $\times 253$.
 Fig. 5. Anterior foot-jaw, male. $\times 253$.
 Fig. 6. Fifth pair of feet, male. $\times 127$.
 Fig. 7. Fifth pair of feet, immature male. $\times 190$.
 Fig. 8. Abdomen, male. $\times 84$.
 Fig. 9. Abdomen, female. $\times 84$.

LV.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander C. F. Oldham, R.N.—Series II., No. 22. Descriptions of new Deep-sea Mollusca.* By EDGAR A. SMITH.

OF the twelve new species about to be described I regret to say that, with one exception, all are based upon single examples which have to be returned to the Indian Museum at Calcutta. Dr. Alcock, the Superintendent of that institution, kindly promises, however, to send to the British Museum any duplicates which may eventually be obtained. The species are to be figured in the "Illustrations of the Zoology of the 'Investigator'."

Some of them are extremely interesting on account of their remarkable form and surface ornamentation, whilst others are peculiar on account of their close similarity to species which occur in the North Atlantic. In one instance, *Puncturella asturiana*, I can find no distinguishing features between the Atlantic and Indian Ocean specimens.

Pleurotoma Kieneri, Doumet.

Pleurotoma Kieneri, Doumet, Mag. de Zool. 1840, pl. x.

Pleurotoma carinata, Reeve (non Gray), Con. Icon. fig. 56; Tryon, Man. Conch. vol. vi. p. 173, pl. iv. fig. 49; Weinkauff, Jahrbuch. deutsch. mal. Gesell. vol. ii. p. 288, pl. ix. fig. 2; Conch.-Cab. p. 15, pl. iii. fig. 1.

Hab. ? (*Ree.*, *Tryon*, *Weinkauff*); China (*Brit. Mus.*); off Ceylon, lat. N. $6^{\circ} 50' 20''$, long. E. $79^{\circ} 36' 20''$, in 180–217 fathoms ('*Investigator*').

Only a single specimen was obtained. The colour is normal, except that the keel below the suture is rather redder than usual and the spotting or dotting upon the ridges encircling the body-whorl is rather fine and inconspicuous.

Pleurotoma carinata, Gray.

Pleurotoma carinata, Gray, Griffith's Cuvier An. King. vol. xii. p. 599, pl. xxiii. fig. 2.

Pleurotoma speciosa, Reeve, Con. Icon. fig. 9; Tryon, Man. Conch. vol. vi. p. 173, pl. iv. fig. 48; Weinkauff, Jahrb. deutsch. mal. Gesell. vol. ii. p. 289, pl. ix. fig. 7 (as *P. nobilis*, Rve., by error); Conch.-Cab. p. 72, pl. xv. fig. 5.

Hab. China, Hong Kong (Weinkauff, Tryon); Bay of Bengal, off Gangetic Delta, in 65 fathoms ('Investigator').

With regard to Reeve's remark that he had seen the type of this species and that it was "identical with the shell subsequently dedicated to Kiener by Doumet," there must have been some mistake. The type from Dr. Gray's collection is now in the Museum, and it belongs unquestionably to the same species as *speciosa*, Rve., and is therefore distinct from *P. Kieneri*. I presume that Reeve's statement must have misled both Tryon and Weinkauff in associating it with the latter. The brownish spots between the nodules on the keel, as represented in Gray's figure, are hardly visible in the shell itself. This, however, is probably a fault in the colouring, so as to give the keel a nodulous appearance. This view of the case is supported by the fact that in the brief description by Gray he describes the shell as "white, whorls keeled," and does not mention the existence of any brown spotting.

Pleurotoma (Ancistrosyrinx) travancorica.

Testa fusiformis, turrita, sordide albida, epidermide tenuissima grisea induta; anfractus normales 7, supra oblique et concave tabulati, supra medium carina dentata tenui sursum erecta instructi, infra carinam recti, contracti, lineis incrementi tenuibus striati, ultimus antice recte et longe rostratus, oblique striatus; apertura cum canali longit. totius $\frac{1}{2}$ paulo superans; labrum tenue, supra carinam ad suturam profunde sinuatum.

Longit. 40 millim., diam. 10.

Hab. Off coast of Travancore, lat. N. $9^{\circ} 34' 57''$, long. E. $75^{\circ} 36' 30''$, in 406 fathoms.

The unique specimen has the nuclear whorls broken away, and consequently they cannot be described. In general appearance it much resembles *P. cedo-nulli*, Reeve, from Panama. In the latter the dentate keel is *at* and not *above* the middle of the whorls, the dentations stand out more horizontally, the upper part of the whorls is less concave and bears a fine spiral liration. The body-whorl is also carinate a little below the dentate periphery.

Pleurotoma (Surcula) profundorum.

Testa breviter fusiformis, alba, periostraco tenuissimo griseo plus minus induta; anfractus normales, in medio concavi, inferne ad suturam tuberculati, infra suturam lineis incrementi angulatis fortibus instructi, ad angulum carinati, et spiraliter striati, ultimus ad peripheriam oblique tuberculatus, infra convexiusculus, liris transverse leviter obliquis tenuibus instructus, antice rostratus; apertura angusta, longit. totius $\frac{1}{2}$ æquans.

Longit. 34 millim., diam. 12.

Hab. N.E. of Maldive Islands, lat. N. $7^{\circ} 05' 45''$, long. E. $75^{\circ} 04'$, in 719 fathoms.

The labral sinus is broad and rather deep and situated at the suture. One specimen only. This species might be placed in Dall's subgenus *Leucosyrinx*, which, however, is scarcely separable from *Surcula*.

Pleurotoma (Surcula) Thurstoni.

Testa fusiformis, albida, periostraco tenuissimo dilute olivaceo induta; anfractus normales 10, paulo infra medium angulati, supra concavi, infra suturam tenuiter plicati, ad angulum oblique et fortius plicati, infra medium spiraliter striati, supra læves, ultimus antice rostratus, lineis incrementi flexuosis aliisque transversis sculptus; apertura longit. totius $\frac{1}{2}$ fere æquans; labrum tenue, superne late et subprofunde sinuatum.

Longit. 40 millim., diam. 13; apertura cum canali 19 longa, in medio 5 lata.

Hab. Off Trincomalee, Ceylon, in 200–350 fathoms.

Named after Mr. Edgar Thurston, of the Madras Museum. In general form recalling *P. javana* (L.). The nodules at the periphery are rather similar, but the fine sutural plicæ are wanting in that species.

Pleurotoma (Surcula?), sp.

Hab. Off Trincomalee, in 200–350 fathoms.

A single immature specimen is all that was obtained. It is shortly fusiform, white, and covered with a very thin periostracum. The whorls are concave above, acutely tuberculated above the suture, finely spirally striated, and marked with fine curved lines of growth. The outer lip is thin, shallowly sinuated above, curved and prominent in the middle. Anterior canal broad, oblique, slightly recurved. Spire conical, short, acute.

Metula clathrata, Ad. & Rve.

Buccinum clathratum, Adams & Reeve, Voy. 'Samarang,' p. 32, pl. xi. fig. 12.

Metula clathrata, H. & A. Adams, Gen. Moll. vol. iii. pl. ix. fig. 4; Tryon, Man. Conch. vol. iii. p. 152, pl. lxxii. fig. 238.

Hab. Cape of Good Hope, in 136 fathoms (*Ad. & Rve.*); off Ceylon, lat. N. $6^{\circ} 50' 20''$, long. E. $79^{\circ} 36' 20''$, in 180–217 fathoms ('*Investigator*').

The single specimen obtained by the '*Investigator*' is of enormous size in comparison with those hitherto described and figured. It is 41 millim. in length, 15 in width, and the aperture is 19 long. Although in dead condition, the brown banding is still traceable. The labrum is thickened both within and without, and bears about twenty short liræ on the inner margin.

Natica (Lunatia) abyssicola.

Testa ovato-globosa, imperforata, alba, periostraco tenuissimo plus minus induta, incrementi lineis obliquis lævibus striata; spira brevis, ad apicem erosa; anfractus 3–4, convexiusculi, ultimus globosus; apertura semicircularis, obliqua; labrum tenue; columella incrassata, superne callo crasso labro juncta; operculum tenue, corneum.

Longit. 9 millim., diam. $8\frac{1}{2}$; apertura 7 longa, 3 lata.

Hab. Arabian Sea, off Cutch, lat. N. $22^{\circ} 14' 25''$, long. E. $67^{\circ} 08' 55''$, in 947 fathoms.

Somewhat resembling *N. pusilla* of Say.

Natica (Lunatia) levis.

Testa globosa, umbilicata, alba, lineis incrementi tenuibus striata, lævigata; anfractus 5, convexi, subgradati; apertura semicircularis, longit. totius $\frac{5}{8}$ adæquans; peristoma tenue, margine columellari inferne leviter incrassato, superne expanso et reflexo; margini exteriori callo tenui juncto; umbilicus simplex, pervius, medioeriter latus; operculum tenue, corneum.

Longit. 16 millim., diam. 14; apertura 10 longa, 6 lata.

Hab. Bay of Bengal, off Coromandel coast, long. E. $81^{\circ} 30' 30''$, lat. N. $15^{\circ} 56' 20''$, in 240–276 fathoms.

Somewhat resembling *N. Fortunei*, Rve., in form, but with the umbilicus wider and without any trace of an internal thickening.

Rostellaria curta, Sowerby.

Hab. Off the Sindh coast, in 20–30 fathoms.

I do not agree with Kiener and Tryon in considering this form a variety of the common *R. curvirostris*. The points of difference referred to by Sowerby and Reeve appear to be persistent; they consist of (1) the shorter body-whorl, (2) the longer and straighter canal, (3) the broad brown band beneath the suture. Judging from the description and figure, *R. luteostoma* of Angas, also considered by Tryon a variety of *curvirostris*, appears sufficiently distinct.

Puncturella (Cranopsis) asturiana (Fischer).

Puncturella (Cranopsis) asturiana (Fischer), Watson, Gaster. 'Challenger' Exped. p. 45, pl. iv. fig. 4; Pilsbry, Man. Conch. vol. xii. p. 241, pl. xxvi. figs. 36, 37; Dall, Bull. Mus. Comp. Zool. Harvard, vol. xviii. p. 404.

Hab. Bay of Biscay, 480-670 fathoms (*Fischer*); W. Indies, 85-640 fathoms (*Dall*); off Culebra Island, West Indies, in 390 fathoms ('*Challenger*'); off west coast of Ceylon, lat. N. $8^{\circ} 35' 45''$, long. E. $81^{\circ} 17' 45''$, in 609 fathoms ('*Investigator*').

Only a single small specimen 7 millim. long was obtained. It agrees exactly in every detail with the West-Indian example dredged by the 'Challenger,' and I feel no doubt with regard to the correctness of this identification.

Dentalium quadrapicale, Sowerby.

Dentalium quadrapicale (Hanley, MSS.), Sowerby, Thes. Conch. vol. iii. p. 103, pl. cccxiii. fig. 61; Conch. Icon. vol. xviii. pl. vii. fig. 46.

Hab. Lat. $9^{\circ} 34' 57''$ N., long. $75^{\circ} 36' 30''$ E. (depth 406 fathoms, bottom green mud, temperature 40° F.); off the coast of Travancore, South India.

The types of this species are said to have come from Cochin. The specimens obtained by the 'Investigator' are somewhat larger than the shell figured by Sowerby, the largest specimen having a length of 40 millim.

Dentalium magnificum.

Testa magna, crassa, mediocriter curvata, postice sensim attenuata, antice oblique truncata, undique costis tenuibus numerosis, striis transversis crenulatis, instructa; fissura angusta, longitudine varia.

Longit. 115 millim., diam. max. 15.

Hab. Lat. $8^{\circ} 40'$ N., long. $81^{\circ} 27' 35''$ E., 637-800 fathoms (bottom green mud, temperature 41° - $42^{\circ} 25'$ F.); off Trincomalee, east coast of Ceylon.

This fine species is as large as the Japanese *D. Vernedei* or the fossil *D. grande*, Desh. The form, however, is more rapidly tapering than that of either, and the sculpture is not precisely similar. The aperture is larger than in either of the species quoted and almost circular. The longitudinal ridges are fine and numerous, numbering about twenty-five to thirty at an inch from the apex. Towards the anterior end intervening riblets appear, so that the interstices, which above are broader than the liræ, become narrower. The lines of growth are distinct, and on crossing the riblets towards the posterior end produce a granulated appearance. The ridges are much smoother anteriorly and less elevated. The length of the fissure is variable; but this is probably chiefly due to damage. In the most perfect specimen it is 13 millim. in length and rather more than half a millimetre in width. All three specimens exhibit reparation of injuries at the anterior end, and in two the posterior extremity has been broken off. These injuries are probably done by fishes or crustaceans. The shells are whitish, but coated with a dark brown earthy deposit. The Rev. Professor H. M. Gwatkin informs me that the radula is quite normal and that the figure given by Sars of *Antalis striolata* closely represents it, except that in the present species "the central tooth is a little wider and the inner edge of the lateral makes a smoother muzzle."

Cardium (Fragum) simillimum.

Testa alba, mediocriter globosa, antice rotundata, postice truncata, quadrata, striis confertis tenuibus radiantibus sculpta, incrementique lineis plus minus decussata, latus posticum versus minute granulata; umbones prominentes, incurvati; pagina interna alba, nitida, marginibus anteriore, postico et ventrali minute denticulatis circumdata; cardo tenuis, dente laterali antico valvæ sinistræ conico, acuto, compresso, postico parvo fere obsoleto.

Longit. 21 millim., alt. 21, diam. 17.

Hab. Off Colombo Lighthouse, in 142-400 fathoms.

A single left valve is all that was obtained of this interesting species. The fine radiating striæ are absent in the lunular region, which consequently is smooth. The granules, arranged in radiating series, appear to be restricted to the hinder part of the shell, judging from the specimen at hand. The sculpture is similar to that of *C. peramabilis*, from 50-125 fathoms in the West-Indian region, as described by Mr. Dall*. The posterior portion of the surface is

* Bull. Mus. Comp. Zool. Harvard, vol. ix. p. 132, vol. xii. p. 269, pl. iv. fig. 7, pl. xl. fig. 4.

somewhat more finely cancellate than the anterior, and is divided off in the same manner by two approximated ribs, but occupies nearly half the valve. The posterior end is distinctly truncate, not curved as in *C. peramabilis*.

Yoldia nicobarica, Bruguière.

Leda nicobarica, Hanley in Sowerby's Thes. Conch. vol. iii. p. 136, pl. cxxiii. fig. 7.

Hab. Nicobar Island (*Chemnitz*); off Delta of Ganges, in 65 fathoms ('*Investigator*').

Two fine specimens of this species were obtained by the '*Investigator*,' the largest being 29 millim. long, $15\frac{1}{2}$ high, and 10 in diameter. They are white, covered with a thin olive periostracum, and not "pale tawny," as described by Hanley.

Yoldia anatina.

Testa magna, oblonga, postice vix rostrata, inæquilateralis, sordide albida, periostraco olivaceo nitente induta, concentrice et oblique tenuiter striata (striis obliquis postice evanidis), haud lunulata; margo dorsi anticus leviter descendens et curvatus, posticus valde longior, declivior, rectiusculus; margo ventris antice curvatus paulo pone medium leviter incurvatus; latus anticum rotundatum, posticum angustius; area dorsi postica linearis, acute marginata; linea cardinis fortis, dentibus anterioribus circiter 24 et posterioribus ad 36 instructa; pagina interna dilute carnea; cicatrices parvæ, subtriangulares; sinus pallii profunda, linguæformis.

Longit. 45 millim., alt. 20, diam. 13.

Hab. Bay of Bengal, off Godavari Delta, in 258-281 fathoms.

The oblique striation is excessively fine and invisible to the naked eye, much finer than in *Y. nicobarica*. One specimen only.

Cuspidaria approximata.

Testa mediocriter tenuis, globosa, postice breviter rostrata, alba, prope marginem ventralem et supra rostrum periostraco luteo induta, lineis incrementi tenuibus sculpta, lirisque obliquis paucis apice radiantibus postice ornata; margo dorsi anticus valde declivis, leviter arcuatus, posticus minus declivis leviter concavus; margo ventris antice valde arcuatus, postice late incurvatus; rostrum cuneiforme, ad extremitatem arcuatim truncatum, dimidio superiore radiatim lirato; umbones prominentes, incurvati, paulo antemediani; cardo in valva sinistra edentulus, in

dextra dente unico laterali acuto postice instructus; fossa ligamenti parva, postice inclinata.

Longit. 15 millim., alt. 11, diam. $9\frac{1}{2}$.

Hab. Off Andaman Islands, lat. N. $11^{\circ} 25' 5''$, long. E. $92^{\circ} 47' 6''$, in 405 fathoms.

Closely allied to *C. cuspidata*, Olivi, but slightly different in form and having a few radiating lines posteriorly.

Myonera bicarinata.

Testa æquivalvis, inæquilateralis, postice hians et breviter rostrata, antice rotundata, alba, tenuis; valvæ tenues, inflatæ, carinis duobus acutis radiantibus post medium instructæ, ante carinam anteriorem concentricæ subdistanter costulatæ, pone carinam læves, lineis incrementi tenuissimis striatæ; umbones prominentes, incurvati; margo dorsi utrinque declivis, ventris antice arcuatus, post et inter carinas excavatus; cardo edentulus; ligamentum internum in fossa angusta in utraque valva situm, ossiculo tenui firmatum.

Longit. 14 millim., alt. 11, diam. 9.

Hab. West of Malabar coast, lat. N. $13^{\circ} 47' 49''$, long. E. $73^{\circ} 07' 0''$, in 636 fathoms.

A very beautiful species, readily distinguishable by its remarkable sculpture. The concentric costæ on the anterior half of the valves are finer and closer together towards the umbo than towards the ventral margin; they do not extend quite to the submedian keel, and become finely attenuated anteriorly.

Lyonsia jucunda.

Testa tenuis, fragilis, oblonga, antice rotundata, postice subtruncata, æquivalvis, inæquilateralis, alba, radiatim carinata, carinis duobus post medium aliis majoribus, omnibus spinulosis vel tuberculatis, undique minute granulata; margo dorsi anticus rectiusculus, valde declivis, posticus longior, minus obliquus, leviter concavus, ventralis inter carinis sinuatus; cardo edentulus; ligamentum internum ossiculo parvo munitum; pagina interna subnacreæ, radiatim sulcata, sulcis punctatis.

Longit. $12\frac{1}{2}$ millim., alt. 8, diam. 6.

Hab. N. Sentinel, bearing N. 15° W. 18 miles, 250 fathoms.

Cryptodon investigatoris, Smith.

Cryptodon investigatoris, Smith, Ann. & Mag. Nat. Hist. 1895, vol. xvi. p. 13, pl. ii. figs. 6, 6 a.

Hab. Off west coast of Ceylon, lat. N. $8^{\circ} 35' 45''$, long. E. $81^{\circ} 17' 45''$, in 609 fathoms.



J. Green del et lith.

Mintern Bros. imp.

MOTHS FROM EAST AFRICA.

Only a single half-grown right valve. It is very much shorter than the specimen figured, being quite as high as long. The form becomes proportionally longer with age, as the growth posteriorly is more rapid than ventrally.

Tellina parvula, Smith.

Tellina parvula, Smith, Ann. & Mag. Nat. Hist. 1895, vol. xvi. p. 10, pl. ii. fig. 3.

Hab. Off Colombo, in 675 fathoms.

The single specimen is rather larger than the type, being $18\frac{1}{2}$ millim. in length and 13 in height.

Scrobicularia ceylonica.

Testa inaequilateralis, alba, nitida, lineis incrementi striata, lunulata; valvæ tenues, medioeriter profundæ, antice late curvatæ, postice breviores, subacuminatæ, anguste hiantes; margo dorsi anticus leviter concavus, parum descendens, posticus valde obliquus; margo ventris pone medium subincurvatus; lunula angusta, lanceolata; ligamentum externum 5 millim. longum, internum parvum, angustum, obliquum; dens cardinalis unicus in utraque valva plus minus bifidus; dentes laterales nulli; pagina interna radiatim substriata; sinus pallii latus, profundissimus.

Longit. 21 millim., alt. 17, diam. 9.

Hab. Off Colombo, in 675 fathoms.

The internal ligament is quite separated from the external one.

Dosinia salebrosa, Römer.

Dosinia salebrosa, Römer, Proc. Zool. Soc. 1860, p. 122; Novitates Conch. p. 50.

Hab. Malacca (*Römer*); west of Cochin, lat. N. $9^{\circ} 34' 57''$, long. E. $75^{\circ} 36' 30''$, in 406 fathoms.

A single specimen, a little smaller than the type, but similar in other respects, is all that was obtained.

LVI.—On a Collection of Moths from East Africa formed by Dr. W. J. Ansorge, Medical Officer to the Uganda Administration. By W. F. KIRBY, Assistant in Zoological Department, British Museum (Natural History).

[Plate XIX.]

DURING Dr. Ansorge's travels in some little-visited parts of East Africa in 1893-1895 he formed a collection of moths, among which were several new or rare species. In the present

paper I publish a full list of the Sphinges, Bombyces, and Noctuæ, and of those Geometræ concerning which any information on habits and localities was available.

Dr. Anson has kindly presented types of the new species (several of which, at his special request, have been named after himself and his family) to the Natural-History Museum.

Cydimonidæ.

CYDIMONINÆ.

1. *Chrysiridia cræsus*.

Thaliura cræsus, Gerstaecker, Arch. f. Nat. xxxvii. p. 361 (1871);
Von der Decken's Reisen, iii. (2) p. 383, pl. xvi. fig. 4 (1873).

Bogomoyo; from Dr. Charlesworth, June 1893.

Three very brightly coloured specimens.

Agaristidæ.

2. *Hespagarista echione*.

Agarista echione, Boisduval, in Delegorgue, Voy. en Afr. Austr. ii. p. 595. n. 115 (1847).

Magwangwara, German East Africa.

Seven specimens, captured between Jan. 8 and Jan. 13, 1894.

3. *Xanthospilopteryx superba*.

Eusemia superba, Butler, Ann. & Mag. Nat. Hist. (4) xv. p. 141, pl. xiii. fig. 3 (1875).

Magwangwara, German East Africa, Jan. 11 and 18;
Mtoto Andai, May 5; Kibwezi, May 7, 1894.

Six specimens obtained, differing considerably in size and intensity of colour.

4. *Xanthospilopteryx fatima*.

Xanthospilopteryx fatima, Kirby, Trans. Ent. Soc. Lond. 1891, p. 288, pl. xv. fig. 2.

Kilungu, April 12, 1894.

One specimen only.

5. *Ægocera triplagiata*. (Pl. XIX. fig. 1.)

Ægocera triplagiata, Rothschild, Novitates Zoologicæ, iii. p. 95 (1896).

Magwangwara, German East Africa, Jan. 11, 1894.

Three specimens obtained.

5 a. *Ægocera triplagiata*, var. (?) n. *dispar*.

Exp. 62 millim.

Body smoky brown; abdomen lighter; front orbits and several spots on the thorax white; palpi porrect, the second joint densely clothed with hair beneath, the hairs black at the base and orange below; proboscis rufous; front legs with the tibiæ densely clothed with orange hairs, except at the base and tip; middle tibiæ marked with orange above near the base and at the middle; hind legs grey; all the tarsi reddish beneath and the hind tibiæ with a pair of very strong terminal spurs, and another long spine about the middle.

Fore wings black, with three transverse white bands, the first near the base, ampulliform, truncated above and rounded below, running obliquely from above the subcostal nearly to the submedian nervure; the second stripe is shorter, truncated above and below, and running between the subcostal nervure and the point where the median nervure forks; the third with nearly parallel sides and extending obliquely from below the costa nearly to the hinder angle; there are some blue lines between and beyond the white bands, more or less continued towards the submedian nervure, especially that between the two outer bands. Hind wings black, the base white to beyond the middle and the fringes whitish. Underside nearly as above; the frenulum reddish, very large, its apex lying below a tuft of buff scales near the base of the inner margin of the fore wings.

There are more scattered blue and white scales on the wings, but the specimens are not in perfect condition.

Four specimens of this insect were taken at the same time and place as *Æ. triplagiata*, which it resembles greatly, except in colour, and of which it is in all probability a dimorphic form.

6. *Protoceræa Geraldi*, sp. n. (Pl. XIX. fig. 3.)

Exp. 33 millim.

Male.—Head and thorax dark brown above; sides of head and middle of thorax crested with white; abdomen and under surface orange-tawny; abdomen with a raised crest at the base above, and with tufts on the sides and at the extremity; antennæ wanting; front legs with black tarsi (the four hind legs wanting).

Fore wings deep red, costa blackish, fringes brown; five white spots, the first oblong, oblique, at the base of the costa; the second small, triangular, subcostal; the third below it,

between the median and submedian nervures, large, round, slightly bordered with black; the fourth and fifth irregularly rotund, resembling the third, nearer the hind margin; between and beyond these white spots are some bluish dashes. Hind wings orange, with broad blackish-brown borders and brown fringes. Fore wings beneath dark brown, with some tawny tufts at the base; the first and third spots are obsolete and the fourth and fifth are connected, the lower one forming an irregular band beneath the upper one, with two deep indentations on its inner side.

One specimen taken at Narogare, Uganda Protectorate, May 19, 1894.

Allied to *P. albigutta*, Karsch, from Lower Guinea (?), but in that species the fore wings are described as black, apart from other differences.

7. *Charilina amabilis*.

Noctua amabilis, Drury, Ill. Ex. Ent. ii. pl. xiii. fig. 3 (1773).

Athi Plain, April 18, 1894; Magwangwara, German East Africa, Jan. 4, 1894.

This is a somewhat variable species, found on both sides of Africa; but the four specimens in the present collection are of rather larger average size than those in the Natural History Museum, measuring from 32 to 41 millimetres in expanse. The smallest specimen before me is from Zomba (*Johnston*) and measures only 30 millim. West-African specimens usually measure about 32 to 35 millim.

Four specimens obtained.

8. *Metagarista triphænoides*.

Metagarista triphænoides, Walker, List Lép. Ins. B. M. i. p. 61. n. 1 (1854).

Port Alice, June 30, 1894.

This is the true *M. triphænoides* of Walker, with bluish markings on the inner margin of the fore wings, and the fore wings dusted with grey. The underside of the fore wings is yellowish orange, with a large black spot in the cell, and a subapical white band, bordered within with black; the apex of the wing is reddish. Walker's type is from an unknown locality, but the British Museum has other specimens from Aburi. Walker placed with his type a specimen of *M. mœnas*, Herrich-Schäffer, from Ashanti, which was subsequently figured by Dr. Butler as *M. triphænoides*; but the fore wings want the blue markings and the grey dusting above, and the under surface is totally different. There is a second spot at

the end of the cell, and the white band is wholly wanting, there being nothing but indistinct brownish submarginal spaces between the nervures, at five sixths of the length of the wing, fading away on the margins; and on the underside of the hind wings there are merely some blackish submarginal lunules towards the costa and anal angle, instead of the distinctly marked brown and reddish border of *M. triphænoides*.

Zygænidæ.

ZYGÆNINÆ.

9. *Zygæna semihyalina*, sp. n. (Pl. XIX. fig. 5.)

Exp. al. 29–30 millim.

Head green; antennæ reddish brown, white towards the tips; thorax reddish brown, scaled with bluish green above; abdomen coppery green. Wings cupreous, bluish green at the base and along the costa and inner margin: fore wings with 5 large transparent spots—one in the cell, a much larger curved one below the cell, another towards the apex, and two between the median nervules; a conspicuous white marginal spot just below the apex: hind wings with a large vitreous spot filling up most of the basal area, and another beyond, only separated by a nervure.

Port Alice, June 30, 1894.

Two specimens in poor condition. Allied to *Z. marina*, Butl., but with much larger vitreous spots.

THYRETINÆ.

10. *Megnaclia sippia*.

Naclia (?) *sippia*, Plötz, Stett. ent. Zeit. xli. p. 78 (1880).

Port Alice, July 19, 1894; Eldoma Ravine, Jan. 16, 1895.

Three specimens obtained.

This curious species, though little known and scarce in collections, appears to be widely distributed in Africa. Plötz described it from the Cameroons; the Natural History Museum possesses a specimen from Old Calabar, and it has now been obtained in East Central Africa.

EUCHROMINÆ.

11. *Euchromia Folletii*.

Glaucopsis Folletii, Gray, in Griffith's Anim. Kingd. xv. pl. cxx. fig. 10 (1833).

Mozambique, July 12, 1893.

Arctiidæ.

PHEGOPTERINÆ.

12. *Metarctia rufescens*.

Metarctia rufescens, Walk. List Lep. Ins. Brit. Mus. iii. p. 769. n. 1 (1855).

One specimen, Mozambique, Nov. 8, with eggs.

SPILOSOMATINÆ.

13. *Alpenus purus*, var.

Alpenus purus, Butl. Proc. Zool. Soc. Lond. 1878, p. 382.

Magwangwara, German East Africa, Jan. 14, 1894. One specimen, more heavily spotted than typical specimens from British East Africa.

ARCTIINÆ.

14. *Callimorpha bellatrix*.

Callimorpha bellatrix, Dalman, Anal. Ent. p. 50. n. 26 (1823).

Mano, Kondeland, Lake Nyasa, Nov. 2, 1893. One specimen.

15. *Callimorpha Thelwalli*.

Hypercompa Thelwalli, Druce, Proc. Zool. Soc. Lond. 1882, p. 779, pl. lxi. fig. 1 (1883).

Mano, Kondeland, Lake Nyasa, Nov. 2, 1893. One specimen.

Cymbidæ.

16. *Earias annulifera* (?).

Earias annulifera, Walker, List. Lep. Ins. Brit. Mus. xxxv. p. 1774 (1866).

Mozambique, July 12, 1893.

One specimen. The type of *E. annulifera* was received from Java.

Lithosiidæ.

17. *Sozusa eborella* (?).

Lithosia eborella, Boisduval, Delegorgue, Voy. Afr. Austr. ii. p. 597. n. 129 (1847).

Magwangwara, German East Africa, Jan. 17, 1894.

A damaged specimen, possibly belonging to this common South-African species.

18. *Utetheisa pulchella*.

Tinea pulchella, Linn. Syst. Nat. (ed. x.) i. p. 534. n. 238 (1854).

Parumbira, Lake Nyasa, Nov. 7, 1893; Ndi, March 30, 1894.

Six specimens were obtained of this widely distributed species.

19. *Argina amanda*.

Enchelia amanda, Boisduval, Delegorgue, Voy. Afr. Austr. ii. p. 597. n. 133 (1847).

Deiopeia ocellina, Walker, List Lep. Ins. Brit. Mus. ii. p. 571. n. 9 (1854).

Var. *Deiopeia cingulifera*, Walker, l. c. p. 569. n. 17 (1854).

Uganda (*Capt. Williams*), June 1893; Mozambique, July 12, 1893; Parumbira, Lake Nyasa, Oct. 25–Nov. 8, 1893; Dar-es-Salam, Jan. 30, 1894.

A very large series of this conspicuous moth, representing both forms noted above.

Hypsidæ.

20. *Egybolia Vaillantina*.

Bombyx Vaillantina, Stoll, Suppl. Cram. Pap. Exot. pl. xxxi. fig. 3 (1790).

Mozambique, July 12, 1893; Magwangwara, German East Africa, Jan. 4 and 19; Kilwa, Jan. 20; Mombasa, March 17; Uganda, Dec. 30, 1894.

Nyctemeridæ.

21. *Aletis Ethelinda*, sp. n.

Exp. al. 52–64 millim.

Body black above, with three rows of white spots; a transverse streak below the antennæ and a central spot beneath (in the male), the whole face in the female, the under surface of the head and abdomen, and the hinder orbits orange-tawny; pectus spotted and legs streaked with white; antennæ in male strongly pectinated. Wings deep orange-red, as in *A. heceta* &c., with broad black borders: fore wings with a large oblique subapical white band and three spots (sometimes traces of a fourth) below: hind wings with rather small oval

spots on the nervures in the middle of the border, 5 in the male and 6 or 7 in the female.

Parumbira, Lake Nyasa, Nov. 8-10, 1894.

Seven specimens obtained. Closely allied to *A. monteironis*, Butl., from Delagoa Bay, except in colour. Druce does not mention the peculiar washed-out colour of *A. monteironis* in his description, but it is shown in the figure in Waterhouse's 'Aid,' ii. pl. clxxii. fig. 2.

22. *Aletis Ericsi*, sp. n.

Exp. 65 lin.

Female.—Body black; head and thorax spotted with white; abdomen with three rows of white spots above; legs reddish; proboscis and abdomen beneath orange-tawny. Wings rather pale orange-tawny (perhaps faded): fore wings with a broad black border, with a broad oblique subapical white band and 3 white spots below it, the first linear: hind wings with a rather narrow black border marked with 7 or 8 moderate-sized white spots on the nervures.

Port Alice, July 19, 1894.

23. *Pitthea trifasciata*.

Pitthea trifasciata, Dewitz, Verh. Leop.-Carol. Akad. xlii. p. 82, pl. iii. fig. 3 (1881).

Uganda, Dec. 29, 1894.

Several specimens obtained.

24. *Secusio parvipuncta*.

Secusio parvipuncta, Hampson, Ill. Lep. Het. B. M. viii. p. 46, pl. cxxxix. fig. 16 (1891).

Tsavo, April 2, 1894.

One specimen only. A common species in India and East Africa.

Genus NEUROXENA, nov.

Body moderately slender; head and abdomen narrower than the thorax. Antennæ slender, slightly serrated. Palpi extending a little beyond the head, the last joint conical and pointed. Fore wings oval, the costa arched; the hind margin regularly curved, hardly oblique, the angles rounded off. Hind wings rounded, as broad and nearly as long as the fore wings. Fore wings with the subcostal nervure apparently 5-branched, but difficult to distinguish owing to the dense scaling. Cell very long and broad, bisected by a

nervure ; upper discoidal nervure forking at the upper end of the cell from the subcostal nervure ; median nervure emitting the lowest branch at about three fifths of the length of the cell ; the middle median nervule and the lower discoidal nervule emitted at equal distances from the upper median nervule and curving away from it ; two very distinct parallel submedian nervures running to the hind margin above the hinder angle ; they are not bifid at the base, where they converge. Hind wings with the costal and subcostal nervures stalked at the base, and then running parallel to the tip. Cell broad, the first subcostal nervule running obliquely upwards from its extremity, the second nearly straight to the inner margin. Discoidal nervule emitted about the middle of the cell, which is merely bisected by a fold ; two upper median nervules forking at the lower end of the cell and the lower one at three fifths of the length of the cell ; two, or perhaps three, submedian nervures, but very slender and ill-defined.

This genus appears to be allied to *Secusio*.

25. *Neuroxena Ansorgei*, sp. n. (Pl. XIX. fig. 2.)

Exp. 46 millim.

Fore wings light brown, with the nervures buff towards the base ; a uniformly broad oblique pale yellow bar running from below the costa, just before the extremity of the cell, nearly to the hinder angle, ceasing above the lowest submedian nervure just before the hind margin. Hind wings pale orange, shading into reddish on the lower and inner half, and with a black border, gradually narrowed and ceasing at the anal angle. Head black, orbits and mouth reddish ; thorax blackish, with long narrow pointed tegulæ, edged on both sides with reddish. Abdomen reddish, with a row of black spots on the back. Pectus yellow ; legs brown.

One specimen taken at Mtebe, July 12, 1894.

26. *Nyctemera leuconoë*.

Nyctemera leuconoë, Hopfner, Monatsb. Akad. Berl. 1857, p. 422 ; Peters's Reise Mossamb. v. p. 430, pl. xxviii. fig. 3 (1862).

Uganda (*Capt. Williams*), June 1893 ; Parumbira, Lake Nyasa, Oct. 25, Nov. 8 ; Isote, Kondeland, Lake Nyasa, Nov. 5, 6, 1893 ; Ndi, March 31, Kibwezi, April 7, Port Alice, June 24, 30, 1894.

Many specimens.

Liparidæ.

27. *Redoa Maria*, sp. n.

Exp. 43 millim.

Iridescent white, thinly scaled, subhyaline, with two silvery-white bands on the fore wings, one submarginal and the other running beyond the cell and angulated beneath it; the cell and basal area are also silvery white. Antennæ deeply bipectinated, brownish grey; face and front legs yellowish.

Mtebe, July 12, 1894.

One specimen. Allied to the Indian species *R. clara*, Walk., and *R. rinaria*, Moore.

28. *Cropera pallida*, sp. n. (Pl. XIX. fig. 6.)

Exp. 24-34 millim.

Fore wings pale yellow with a slight orange tint, with three or four irregular and indistinct transverse whitish bands; an orange spot in the middle of the wing and frequently some blackish scaling below it, and traces of one or two blackish spots towards the hind margin. Hind wings pale yellow, unspotted. The female has pale yellow fore wings, hardly varied with whitish, but with the central orange spot; two blackish submarginal spots, one towards the costa and one towards the inner margin; and a greyish-brown tuft at the extremity of the abdomen.

Four specimens.

Noted as abundant on the coast at Mozambique in 1893: the Natural History Museum has specimens from Natal and Delagoa Bay.

29. *Olapa fulvinotata*.

Olapa fulvinotata, Butler, Proc. Zool. Soc. Lond. 1893, p. 678.

Magwangwara, German East Africa, Jan. 8, 1894.

One specimen.

30. *Cypra crocipes*.

Cypra crocipes, Boisduval, Faune Madag. p. 87, pl. xii. fig. 2 (1833).

A single specimen labelled "Uganda (*Capt. Williams*)," apparently identical with this well-known Madagascar species.

31. *Rhanidophora phedonia*.

Bombyx phedonia, Cramer, Pap. Exot. iv. pl. cccxlvii. fig. C (1782).

Maungu, March 27; Port Alice, June 24; Uganda, Dec. 29, 1894.

Several specimens.

32. *Aroa discalis*.

Aroa discalis, Walker, List Lepid. Ins. Brit. Mus. iv. p. 792. n. 1 (1855).

Quilemane, Portuguese East Africa, July 23, 1893.

One specimen of this common East-African moth.

Limacodidæ.

33. *Parasa celtitis*.

Teda celtitis, Wallengren, Wien. ent. Mon. vii. p. 141 (1863); Vetensk. Akad. Handl. (2) v. (4) p. 23 (1865).

Kisokwe (*per* Rev. Mr. Ashe, June 1893).

Two specimens.

Notodontidæ.

34. *Rigema Woerdeni*.

Phalera Woerdeni, Snell. Tijdschr. Ent. xv. p. 45, pl. iv. figs. 1-3 (1865).

Masongoleni, June 4, 1894.

One specimen.

Sphingidæ.

MACROGLOSSINÆ.

35. *Aëllopus hirundo*.

Macroglossa hirundo, Gerstaecker, Arch. f. Naturg. xxxvii. p. 360 (1871); Von der Decken's Reisen, iv. (2) p. 375, pl. xv. fig. 7 (1873).

Ngomeni, April 3, 1894; Kibwezi, Feb. 6, 1895.

36. *Macroglossa trochilus*.

Psithyrus trochilus, Hübn. Samml. exot. Schmett. ii. pl. clviii. (1824?).

Eldoma Ravine, Jan. 16, 1895.

One specimen only.

37. *Macroglossa trochiloides*.

Macroglossa trochiloides, Butler, Proc. Zool. Soc. Lond. 1875, p. 5.

Eldoma Ravine, May 7, 1894.

One specimen. This insect was originally described from Sierra Leone. Dr. Butler is now inclined to doubt whether it is really distinct from *M. trochilus*, Hübner.

AMBULICINÆ.

38. *Nephele viridescens*.

Zonilia viridescens, Walker, List Lep. Ins. Brit. Mus. viii. p. 192. n. 1 (1856).

Parumbira, Lake Nyasa, Nov. 11, 1893.

One specimen.

Saturniidae.

39. *Gynanisa maia*, var. (?)

Saturnia maia, Klug, Neue Schmett. pl. v. fig. 1 (1836).

Magwangwara, German East Africa, Jan. 13, 1894.

Specimens from Tropical East Africa are larger and paler than those from Natal, and represent a distinct local form, if not a new species.

40. *Pseudaphelia apollinaris*.

Saturnia apollinaris, Boisduval, Delegorgue, Voy. Afr. Austr. ii. p. 601 (1847).

Magwangwara, German East Africa, Jan. 3-11, 1894.

A long series.

41. *Saturnia oubie*.

Bombyx oubie, Guérin, Lefevre, Voy. Abyss. Zool. vi. p. 387, pl. xii. figs. 1, 2 (1849).

Lake Nakwo, May 3, 1894.

A pair (male and female), showing that the sexes do not differ. They agree with Somali specimens and differ from the figure and description of the type in the transverse pale lines on the wings being white, and not pink.

42. *Saturnia* —?

Ekatetok, May 18, 1894.

A very worn male of a species allied to *S. oubie*, Guérin, and *S. Zaddachi*, Dewitz, with a broad yellow border edged with black on the hind wings. The condition of the specimen renders it useless to attempt to describe it.

Genus LASIOPTILA, nov.

Female.—Antennæ moniliform, with about twenty-four joints, the last conical, thickly clothed with very short hair; the joints of nearly uniform length, hardly longer than

broad, and very distinctly separated. Thorax and legs thickly clothed with shaggy hair. Wings very hairy, fringes thick and moderately long: fore wings not much longer than broad, the costa arched towards the extremity, and the hind margin rounded and not very oblique; most hairy along the costa and at the base, where there is a dense mass of raised hair, extending below the median nervure and its lowest branch to beyond the middle of the inner margin: hind wings rounded, with the inner margin concave.

A very distinct genus, allied to *Ludia*, Wallengren (type *Saturnia Delegorguei*, Boisd.), from which it differs *inter alia* by the totally different colour and pattern, and the much shorter and broader fore wings.

43. *Lasioptila Ansorgei*, sp. n. (Pl. XIX. fig. 8.)

Female.—Rich fawn-colour, slightly varied with rosy grey; prothorax grey above, a blackish line at the base of the fringes, edged inside with rosy grey, the fringes slightly paler in the middle and darkest at the extremities; there is also a regularly festooned submarginal line, blackish on the fore wings, and reddish on the hind wings. Fore wings with a slight transverse black dash towards the base, a narrow vitreous lunule bordered with black on both sides, and with the horns turned outwards, at the end of the cell, and a broad black dash suffused above in the middle of the inner margin; on its outer edge the submarginal festooned line runs into it. Hind wings with a narrow black lunule opening outwards and most distinct on the underside, at the end of the cell. Underside irrorated with reddish atoms, except on the disk of the fore wings, and with rows of yellowish hairs along the nervures, which are less conspicuous on the upperside.

Uganda, Dec. 22, 1894.

One specimen only obtained.

44. *Lasioptila* (?) *pomona*. (Pl. XIX. fig. 9.)

Dreata pomona, Weymer, Stett. ent. Zeit. liii. p. 113 (1892).

Magwangwara, German East Africa, Jan. 8, 1894.

A single male specimen; the type specimen, of which I have seen a drawing in Herr Weymer's possession, is also a male. The generic characters agree in most particulars with *L. selene*, but the insect is smaller and the wings much less densely hairy; the antennæ are about 33-jointed, the joints closely united, rather longer than broad, and deeply bipectinated and ciliated. The end of the cell on all the wings is marked with

a white (or vitreous?) spot bordered with blackish, beyond which is an oblique yellow stripe bordered outside with brown, but no festooned submarginal line.

I see no reason to regard this moth as the male of *L. selene*; but when these species are better known I expect it will prove to belong to the same genus, or to an allied one.

Lasiocampidæ.

45. *Jana Mariana*.

Bombyx Mariana, White, Ann. & Mag. Nat. Hist. xii. p. 264 (1843).

Captured October 26.

A female specimen of large size (exp. 150 millim.), but not otherwise differing materially from the type from the Congo.

46. *Hibrildes Ansongei*, sp. n. (Pl. XIX. fig. 7.)

Exp. 60 millim.

Female.—Body reddish brown; antennæ strongly bipectinated; face orange; thorax white in front and on the sides; abdomen with an orange band on the back, expanding at the end of each segment, the sides whitish, bordered below with an orange stripe on each side; terminal segment orange. Fore wings smoky hyaline, with black cilia; a blackish mark at the end of the cell, beyond which is a broad white band extending nearly to the lowest median nervule, its lower part connected outwardly with a row of submarginal white spots between the nervures, which do not extend to the costa. Hind wings tawny yellow, with a broad lunule at the end of the cell; a rather narrow black border, marked with six large white spots between the nervures.

Magwangwara, German East Africa, Jan. 19, 1864.

Two specimens obtained.

47. *Hibrildes venosa*, sp. n. (Pl. XIX. fig. 4.)

Exp. 57 millim.

Male.—Creamy white, subhyaline, with the nervures brown, incrassated, and expanded triangularly before the fringes, which are also brown on the costa and hind margin of all the wings, but white on the inner margins. Fore wings with the costal area yellowish; tips brownish, and throwing off a short brown submarginal band, ceasing on the lowest discoidal nervule, where it turns outward to the margin. The fork of the discoidal nervule before the end of

the cell of the fore wings is shorter than in *H. norax*, Druce. Underside with the costal area on all the wings distinctly yellowish. Antennæ black; head orange; thorax clothed with yellow hair; abdomen reddish.

Magwangwara, German East Africa, Jan. 16 and 19, 1894.

Three specimens obtained.

Allied to *H. norax*, Druce, the type of the genus; but in that species the thorax is white and the wings are also much whiter than in *H. venosa*. It may be the male of *H. Ansorgei*.

48. *Lichenopteryx conspersa*, sp. n.

Exp. 53 millim.

Male.—Anterior wings and thorax buff; antennæ very long, brown, very deeply bipectinated; head, hind wings, and abdomen ochreous-yellow, the latter with lighter bands; tarsi ringed with black at the base. Head and thorax with long hair, forming a double raised crest on the head, but more depressed on the thorax. Wings very densely clothed with scales and hair: fore wings with many scattered brown and black spots, the latter often punctiform; a suffused blackish band, sloping slightly inwards at about two thirds of the length of the wing: hind wings nearly immaculate above; wings beneath of a uniform greyish buff, with scattered black points on the hind wings except towards the base, and on the fore wings towards the base of the costa, and in a position corresponding to that of the dark band in the upperside. Wings broad, rounded; hind wings nearly as long and broad as the fore wings.

Kisokan River.

Two specimens (a male and female) in very poor condition, especially the latter.

49. *Stenoglene obtusa*.

Poloma obtusa, Walker, List Lep. Ins. Brit. Mus. xxxii. p. 357 (1865).

Maungu, March 16, 1895.

One specimen.

NOCTUÆ.

Coradiniidæ.

50. *Amyna selenampha*.

Amyna selenampha, Guenée, Noct. i. p. 406 (1852).

Mtoto Andai, April 5, 1894.

Acontiidæ.

51. *Tarache cafraria*.

Noctua cafraria, Cramer, Pap. Exot. ii. pl. cxlvii. fig. F.

Tsavo, April 2, 1894.

One specimen.

Anthophilidæ.

52. *Eublemma viridula*.

Micra viridula, Guenée, Ann. Soc. Ent. France, x. p. 249, note (1841);
Noct. ii. p. 244 (1852).

Isote, Kondeland, German East Africa, Oct. 31, 1893.

Also occurs in South Europe.

Toxocampidæ.

53. *Plecoptera reversa*.

Poaphila reversa, Walker, List Lep. Ins. Brit. Mus. xxxiii. p. 991
(1865).

Magwangwara, German East Africa, Jan. 13, 1894.

An unusually brightly coloured female.

Polydesmidæ.

54. *Pandesma Quenavadi*.

Pandesma Quenavadi, Guen. Noct. ii. p. 438 (1852).

Parumbira, Lake Nyasa, Oct. 25, Nov. 8; Isote, Kondeland, Lake Nyasa, Nov. 6, 1893.

55. *Polydesma umbricola*.

Polydesma umbricola, Boisd. Faune Madag. p. 108, pl. xiii. fig. 5 (1833).

Parumbira, Lake Nyasa, Nov. 6-14, 1893.

Ophideridæ.

56. *Argadessa materna*.

Noctua (?) *materna*, Linn. Syst. Nat. (ed. xii.) p. 840. n. 117 (1767).

Magwangwara, German East Africa, Jan. 13, 1894.

Ommatophoridæ.

57. *Patula Walkeri*.

Patula Walkeri, Butler, Ann. & Mag. Nat. Hist. (4) xvi p. 406 (1875).

Parumbira, Lake Nyasa, Nov. 16, 1893.

58. *Cyligramma latona*.

Noctua latona, Cramer, Pap. Exot. i. pl. xiii. fig. B (1775).

Parumbira, Lake Nyasa, Nov. 10, 1893; Magwangwara, German East Africa, Jan. 2; Ndi, British East Africa, April 1894.

Several specimens.

59. *Cyligramma limacina*.

Erebus limacina, Guér. Icon. R. Anim., Ins. p. 520, pl. lxxxix. fig. 2 (1839-44).

Uganda (*Capt. Williams*), June 1893; Gote, Kondeland, Lake Nyasa, Nov. 6, 1893; Magwangwara, German East Africa, Jan. 18; Masongoleni, April 6, 1894, Feb. 7, 1895; Ndange, April 3, 1895.

Hypopyridæ.

60. *Pyramarista rufescens*, gen. et sp. n.

Male.—Exp. 81 millim.

Fawn-colour, tinged with rosy on the costa and inner margin of the wings, most broadly on the inner margin of the fore wings and most deeply on the long fringes of the inner margin of the hind wings. Antennæ with a row of short, sharp, triangular teeth on each side, terminating in a slender curved bristle, finely ciliated on the curve. Body and femora clothed with rosy hair; thorax damaged, but the front tufts are rosy and the hinder tufts pale grey. Fore wings with a triangular black spot on the middle of the costa; a brown line crosses the end of the cell, curves outwards, and then slopes obliquely inwards to nearly the middle of the inner margin. A white line, bordered inside with rosy brown, runs from the tip of the fore wings to just within the anal angle of the hind wings. Underside more pink, without markings except the common outer line, which is pink. Legs long, femora very pilose, middle tibiæ with terminal and hind tibiæ with middle and terminal spurs; tibiæ and tarsi armed on the sides and beneath with rows of fine black spines. Abdomen with a small anal tuft.

Allied to *Hypopyra Bosei*, Saalmüller, from Madagascar (which is placed in *Maxula* in the British Museum collection), but its smaller size and rosy tinge give it more the general appearance of some varieties of *Hypopyra vespertilio*, Fabr. The teeth of the antennæ, too, are much more regular and conspicuous, and the joints are very distinctly separated; nor do the antennæ taper as in *H. Bosei*, which, however, should probably form a genus equally distinct from *Maxula* and *Pyramarista*.

Parumbira, Lake Nyasa, Nov. 15, 1893.

A single worn specimen; but the species is of so much interest that I was unwilling not to describe it.

61. *Maxula africana*, sp. n.

Exp. 45-53 millim.

Male.—Wings grey, dusted with black, with a submarginal white stripe running from within the costa of the fore wings to the hinder angle, and from the tip to the anal angle of the hind wings; this line is bordered on both sides with dusky, and is followed on its inner side by a space nearly free from black specks, as is also the cell of the fore wings; the space between this line and the hind margin is darker than the rest of the wings, and there is a row of black spots between the nervures towards the hind margin, and the marginal one is also marked by a darker patch below the middle on all the wings. Fore wings with four black costal spots, increasing in size from the base; the basal one is the outermost of a row of three at the base, progressively smaller and more basal as they descend; under the second are some black dashes towards the inner margin; the third surmounts a very large brown irregularly ampulliform blotch, surrounded by a black line, the neck of which is widened above, and bounds the end of the cell, expanding beneath into the flask-shaped spot; the fourth is followed below by a row of five small black spots (the fourth nearer the margin than the others), which nearly reach the outer edge of the large spot; about the middle of the inner margin is a black dash, forming the commencement of an oblique blackish stripe which crosses the hind wing before the middle; costa and inner margin of the hind wings, including the long fringes of the latter, rosy. Underside orange-tawny, with three rows of black spots, the inner row incomplete on the lower part of the fore wings and on the upper part of the hind wings, and the outer row punctiform; there is a black lunule at the end of the cell of the fore wings, and two small blackish marks at a point

corresponding to the centre of the flask-shaped spot of the upperside; there is also a black spot on the discocellular nervules of the hind wings.

Head and antennæ rufous-brown; thorax and base of abdomen whitish above: abdomen above and most of the body beneath inclining to rosy; femora clothed with thick reddish hair; tibiæ and tarsi black above.

Female much lighter, especially on the fore wings; the submarginal line and dots present; only the third and fourth of the costal spots of the fore wings visible; the third forms the uppermost of a row of four black spots crossing the end of the cell. Underside with only the submarginal line and the lunule and spot at the end of the cells distinctly visible; body, as well as the wings, only with a very faint rosy tinge; legs brown.

Magwangwara, German East Africa, Jan. 11 and 13, 1894.

Allied to the common and variable East-Indian *M. unistrigata*, Guen., but without the zigzag lines and rows of black dots on the disk which we meet with in that species.

Wallengren describes two species of *Hypopyra* from Caffraria, one of which—*H. miniata*—may prove to be the female of our *Pyramarista rufescens*.

62. *Entomogramma nigriceps*.

Renodes (?) *nigriceps*, Walker, List Lepid. Ins. Brit. Mus. xv. p. 1595. n. 6 (1858).

Uganda, Dec. 29, 1894.

63. *Entomogramma pardus*.

Entomogramma pardus, Guenée, Noct. iii. p. 205 (1852).

Mozambique, July 12, 1893.

Ophiusidæ.

64. *Sphingomorpha monteironis*.

Sphingomorpha monteironis, Butler, Ann. & Mag. Nat. Hist. (4) xvi. p. 406 (1875).

Parumbira, Lake Nyasa, Oct. 23, Nov. 9–14, 1893.

Several specimens.

65. *Pseudophis tirhaca*.

Noctua tirhaca, Cram. Pap. Exot. ii. p. 172, fig. E (1780).

Magwangwara, German East Africa, Jan. 3, 1894.

66. *Dysgonia senior*.

Ophisma senior, Walker, List Lep. Ins. Brit. Mus. xiv. p. 1376. n. 17 (1858).

Port Alice, June 24, 1894.

67. *Achæa Lienardi*.

Ophiusa Lienardi, Boisduval, Faune Madag. p. 102, pl. xv. fig. 5 (1833).

Parumbira, Lake Nyasa, Nov. 11 and 14, 1893; Ndi, March 31; Masongoleni, April 6, 1894.

68. *Ophiusa algira*.

Noctua algira, Linn. Syst. Nat. (ed. xii.) i. (2) p. 835. n. 98 (1767).

Kilungu, April 12; Uganda, Dec. 30, 1894.

69. *Colbusa euclidica*, var.

Colbusa euclidica, Walker, List Lepid. Ins. xxxiii. p. 978 (1865).

One specimen in poor condition from Taligan.

The white band on the fore wings is broader than in the types, and the upper part of the border narrower; but the species appears to be variable, and a larger series is needed before it would be advisable to separate the various forms as distinct.

70. *Grammodes geometrica*.

Noctua geometrica, Fabricius, Syst. Ent. p. 599. n. 37 (1775).

Magwangwara, German East Africa, Jan. 5, 1894.

Euclidiidæ.

71. *Trigonodes hyppasia*.

Noctua hyppasia, Cramer, Pap. Exot. iii. pl. ccl. fig. E (1780).

Mozambique, July 12, 1893.

72. *Drasteria judicans*.

Ophiusa judicans, Walker, List Lepid. Ins. Brit. Mus. xv. p. 1831 (1858).

Exact locality not recorded; labelled "298."

Remigiidæ.

73. *Remigia archesia*.

Noctua archesia, Cram. Pap. Exot. iii. pl. cclxxiii. figs. F, G (1780).

Mozambique, July 12, 1893; Magwangwara, German

East Africa, Jan. 13; Kilungu, April 12; Port Alice, July 19; Uganda, Dec. 29, 1894.

74. *Remigia frugalis*.

Noctua frugalis, Fabricius, Syst. Ent. p. 601. n. 45 (1775).

Magwangwara, German East Africa, Jan. 11 and 13; Uganda, Dec. 29 (1894).

Hypenidæ.

75. *Hypena abyssinialis*.

Hypena abyssinialis, Guenée, Delt. & Pyr. p. 39 (1854).

Isote, Kondeland, Lake Nyasa, Nov. 2, 1893; Magwangwara, German East Africa, Jan. 11, 1894.

G E O M E T R Æ.

76. *Gnophos delosaria*.

Tephrosia delosaria, Walker, List Lepid. Ins. xxv. p. 1541 (1862).

Isote, Oct. 31.

77. *Zamorada reflexaria* (?).

Comibæna reflexaria, Walker, List Lepid. Ins. Brit. Mus. xxvi. p. 1565 (1862).

Isote, Kondeland, Lake Nyasa, Nov. 6, 1893.

A damaged specimen, apparently belonging to this species.

78. *Paraeumelea conspersata*, sp. n.

Exp. al. 45 millim.

Pale yellow, thickly speckled with brown, with black discoidal spots; the fore wings are clearer towards the costa, and towards the hind margin the speckled part is bordered by a festooned line, commencing with an outward curve below the costa, followed by two even curves and then by three oblique ones to the inner margin; outside this is a submarginal curved row of blackish dots on the nervures, between which and the festooned line are some irregular brown spots; on the hind wings the line is continued nearly straight, but only for a short distance from the costa, and below it the speckled part of the wing extends outwards as far as three brown festooned submarginal lines, coalescing to two on the costa,

the outer series marked between the nervures with black dots, slightly speckled with silver; the fringes on all the wings are yellowish white, preceded by a brown line. Underside whitish, with the brown markings more clearly defined than above; body brown, with the face yellow, marked with a transverse brown bar; the abdomen is marked with some irregular yellowish patches.

Port Alice, June 24, 1894.

Two specimens obtained.

Allied to *P. perlimbata*, Guenée, but that species has orange markings, and a row of long submarginal streaks in place of the brown submarginal lines of *P. conspersata*.

79. *Problepsis digammata*, nom. nov.

Problepsis digammata, Warren, MS.

Argyris latonoria, var., Walker, List Lepid. Ins. Brit. Mus. xxiii. p. 807. n. 2 (1861).

Uganda, Dec. 29, 1894.

80. *Negla perplexata*.

Negla perplexata, Walker, List Lepid. Ins. Brit. Mus. xxiv. p. 1087. n. 1 (1862).

Port Alice, June 30, 1894.

81. *Petovia dichroaria*.

Geometra dichroaria, Herrich-Schäffer, Aussereurop. Schmett. i. fig. 169 (1854).

Magwangwara, German East Africa, Jan. 5, 1894.

Two specimens obtained.

EXPLANATION OF PLATE XIX.

Fig. 1. *Ægocera triplagiata*, Rothsch.

Fig. 2. *Neuroxena Ansorgei*, sp. n.

Fig. 3. *Protoceraea Geraldi*, sp. n.

Fig. 4. *Hibrildes venosa*, sp. n.

Fig. 5. *Zygena semihyalina*, sp. n.

Fig. 6. *Cropera pullida*, sp. n.

Fig. 7. *Hibrildes Ansorgei*, sp. n.

Fig. 8. *Lasioptila Ansorgei*, sp. n.

Fig. 9. *Lasioptila* (?) *pomona*, sp. n.

LVII.—On a little-known Australian Fish (*Threpterus maculosus*, *Richardson*), with Remarks on the Family Cirrhitidæ.
By G. A. BOULENGER, F.R.S.

IN 1850 the late Sir John Richardson described and figured a fish from King George's Sound, where it is called by the natives "Cūmbeūk"; it was regarded by him as allied to *Latris* and *Chilodactylus*, but differing in the presence of vomerine teeth and in the teeth in the jaws being short, conical, and confined nearly to a single row, instead of being setiform and crowded. For this fish a new genus and species were established, named *Threpterus* * *maculosus* (Proc. Zool. Soc. 1850, p. 70, pl. ii. fig. 1).

I do not know what has become of the dried skins of Mr. Neill's, from which the fish was described by Richardson. They are not in the British Museum and they were never examined by Dr. Günther, as is obvious from the fact of his referring the fish to the genus *Chironemus*, with "villiform teeth in both jaws." In fact the species has never been rediscovered since its original description.

I was therefore not a little surprised to find among a collection from Victoria, recently acquired by the Trustees of the British Museum, a fine specimen which is undoubtedly identical with the long-lost *Threpterus maculosus*. It shows the genus *Threpterus* to be valid, for, although nearest allied to *Chironemus*, it differs in the dentition, the teeth being conical and subequal, in two or three rows in the præmaxillary, in one row in the mandible. I append a description of the single specimen, obtained on the Melbourne market:—

D. XIV 17. A. III 7. Sc. 55 $\frac{9}{16}$; l. l. 55.

Depth of body equal to length of head, $3\frac{1}{2}$ in total length. Diameter of eye $1\frac{1}{2}$ length of snout, $\frac{1}{4}$ length of head, nearly double interorbital width; maxillary extending to below centre of eye; upper surface of head and cheeks naked, opercles scaly; two opercular spines. Gill-membranes broadly connected; gill-rakers moderate, 14 on lower part of anterior arch. Dorsal originating just behind the occiput, the spinous portion a little longer than the soft; fifth spine longest, $\frac{2}{3}$ longest soft rays, $\frac{1}{2}$ length of head; last spine little more than $\frac{1}{2}$ length of fifth. Pectoral as long as head,

* *Θρεπτήριος*, ad alendum idoneus.

8 lower rays entire and free distally. Ventrals a considerable distance behind the base of the pectorals. Second and third anal spines equal, as long as second dorsal. Caudal rounded. Dark grey-brown, vermiculated with black; a mother-of-pearl black-edged spot on the opercular membrane between the spines; fins spotted and marbled with black; pectorals with five black bands.

Total length 380 millim.

I also wish on this occasion to offer a few remarks on the systematic position of the genus *Threpterus* and others which have hitherto been placed in its neighbourhood, but whose relations have been misunderstood.

It has been stated above that the genus *Threpterus* is allied to *Chironemus*; this receives confirmation from an examination of the vertebræ made on the spirit-specimen. The two genera further agree in the absence of suborbital lamina, an important character which separates them from the other genera with which they have been associated in the family Cirrhitidæ. An examination of the skeletons shows this family to be a most artificial group. Gill has long ago endeavoured to rearrange its contents, which he divides into two families—Cirrhitidæ and Haplodactylidæ; but these are still brigaded in a super-family—Cirrhitoidæ—in his classification of 1893 (Mem. Ac. Washington, vi. p. 127). There can be no question, however, that, if a natural arrangement be attempted, the only way to deal with the group will be to disband it altogether. Then *Cirrhitæ* will enter the family Serranidæ, in which it may form a sub-family, Cirrhitinæ, characterized by the structure of the lower pectoral rays and the absence of air-bladder; *Chilodactylus*, with parapophyses to all the vertebræ and no vomerine teeth, will go and join *Haplodactylus* in the Sparidæ; whilst *Chironemus*, *Threpterus*, and *Latris* will constitute a distinct family—Latrididæ—agreeing with the Serranidæ in the vertebral column and vertical fins, but distinguished by the absence of an internal process of the second suborbital supporting the globe of the eye.

The following tabular arrangement shows the differences in the structure of the vertebral column in the genera formerly grouped together as Cirrhitidæ:—

	A.	B.	C.	D.	E.	F.	G.	H.
<i>Cirrhites</i>	26	10	2	1	0	6	5	16
<i>Chironemus</i> ..	33	13	2	1	0	10	5	20
<i>Threpterus</i> ..	33	13	2	2	0	9	6	20
<i>Latris</i>	35	14	2	2	0	12	4	21
<i>Chilodactylus</i> .	35	14	2	0	0	12	1	21

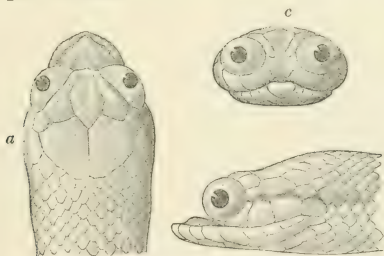
A. Total number of vertebræ. B. Præcaudal vertebræ. C. Ribless anterior vertebræ, bearing only epipleurals. D. Vertebræ with sessile ribs and no transverse processes. E. Vertebræ with sessile ribs and transverse processes. F. Vertebræ with ribs attached to transverse processes. G. Præcaudal vertebræ with the transverse processes united to form a closed hæmal arch, with or without hæmal spine. H. Caudal vertebræ.

LVIII.—On a case of Simous Malformation in a Snake.

By G. A. BOULENGER, F.R.S.

WE have long been familiar with a curious monstrosity in salmon and trout known as the "pug-nose," which consists in the snout being aborted whilst the lower jaw retains its normal development and projects forwards far beyond the skull. I am now able to place on record a perfectly analogous malformation in a Tropical American Opisthoglyph snake—*Stenorhina Degenhardti*.

The specimen, obtained by Mr. Underwood in Costa Rica, is half-grown, measuring 330 millim. It will be seen from the annexed figure that the snout is entirely absent and the eyes strongly protrude in front; the mandible, on the other hand, is quite normal.



a, upper view of head; b, side view; c, front view.

Whether the malformation in this case is congenital or arose from an accident during life we have no means to tell; but, whatever may be its cause, it is a matter for wonder how a snake should be able to maintain itself in that condition. The power to secure its food must have been derived mainly from the posterior grooved fangs, the portion of the maxillary that supports them being, together with the pterygoids, all that remains of the maxillo-palatal arch.

LIX.—*On Contrasts in the Marine Fauna of Great Britain.*
By Prof. M'INTOSH, M.D., LL.D., F.R.S., &c.*

I HAVE drawn together some of the impressions made by an examination of the littoral fauna, and that within a few miles of the shore, at the four points of the compass in the British area, leaving out, however, on the present occasion all reference to Ireland. Thus, for the north Shetland, for the south the Channel Islands, for the east St. Andrews, and for the west the Outer Hebrides have been selected. As, however, a long stretch of English coast on both sides would have been left out, it has been thought desirable to supplement these in certain cases by similar investigations at Scarborough, the Tees, the Humber, and the Orwell on the east, and at Southport and the Isle of Man on the west; whilst on the south the Isle of Wight and Plymouth give some useful data.

The whole British marine area is included in the Celtic province of Edward Forbes, the Shetland Islands alone in the north having an admixture of boreal forms, while the Channel Islands present an admixture of southern types, or, as Forbes called them, Lusitanian forms. I may explain in passing that this accomplished naturalist grouped the seas of Western Europe into five provinces, viz. the Arctic, Boreal, Celtic, Lusitanian, and Mediterranean, each of these being one of his centres of creation, for he believed that nowhere do we find a province repeated—"that is to say, in none except one centre of creation do we find the same assemblage of *typical* species, or, in other words, no species has been called forth originally in more areas than one." The vast advances which have been made in marine exploration, however, since the publication of his 'Natural History of the European Seas' (1859) have levelled some of his barriers and have shown how wide the distribution of many species is. Yet even in so limited an area as that of the seas of Britain we shall find certain interesting facts underlying the generalizations of Forbes.

In the brief compass of a more or less simple introductory lecture it is, of course, impossible to give a detailed or complete view of the four points selected. It becomes necessary, therefore, to choose only the most salient features for review and discussion, a preference, moreover, being given for those which in one way or other bear on problems of general interest.

* The Introductory Lecture to the Class of Natural History, University of St. Andrews, 9th October, 1896.

Without further introduction, therefore, we shall at once proceed to examine the conditions at St. Andrews, which during the present generation has come to be a zoological centre for the east coast, though in former years other places, such as the Forth in the days of Professors Forbes and Allman, Berwick-on-Tweed in the time of Dr. George Johnston, and the northern shores of England under the fostering influence of Joshua Alder and Albany Hancock, attained great prominence.

If we take a general glance between tide-marks at St. Andrews the great abundance of the crumb-of-bread sponge (*Halichondria panicea*) is noteworthy, covering as it does several square feet in certain places, and it is equally abundant in the Laminarian region. Where an admixture of fresh water, moreover, occurs, as in the estuaries of the Forth and the Tay, the growth of this species is remarkable. With the exception, perhaps, of *Chalina* other sponges are not conspicuous, though they are by no means absent.

Of zoophytes we have *Clava multicornis* under stones and on *Cynthia*, and *Gonothyræa Lovéni* in vast profusion on the finely grown submerged mussels of the Eden, forming a network upon which the pelagic young mussels settle as minute points or grains in summer, and, after growing a little, are swept off by the annual decay of the zoophyte at the end of autumn. The frequency of *Sertularia pumila* and of *Sertularella rugosa* near low-water mark is another feature, as also is the occurrence of large Corymorphæ in a limited inshore area, and of large Lucernariæ on *Fuci* at the tidal rocks. The striking pelagic members of this group are *Halistemma* and *Lesueuria*, while the common *Beroë* and *Pleurobrachia* are very abundant amidst swarms of Hydromedusæ, including *Aglantha* and *Hybocodon*. The common sea-flowers (*Actinia mesembryanthemum* and *Tealia crassicornis*) are plentiful, or, rather, I should say, were plentiful, for the fishermen have found them so attractive as bait for cod that they have in several places almost exterminated them. The sandy bay is likewise the home of *Peachia* and its allies—*Edwardsia* and *Cerianthus*. The deeper water, again, is characterized by the rare *Hormathia* and by the sea-pens *Pennatula* and *Virgularia*.

The most interesting starfish between tide-marks is the little *Asterias Mülleri*, which is found under stones in pools, and in the early months of the year it carries its eggs over the mouth and hatches them there, as does also the purple *Cribrella* which accompanies it. Larval starfishes are plentiful in summer and autumn, including the remarkable one of *Luidia*.

Amongst the worms the abundance of the spoon-worm (*Echiurus Pallasii*) is a striking feature, together with the prevalence of sand-dwelling forms, such as *Magelona*, *Ophelia*, and *Nephtys*. The occurrence of the gigantic epitocous form *Alitta virens* is also noteworthy. In the tow-nets the larval types *Tornaria* and *Mitraria* occasionally appear, along with *Polygordius*.

The crabs exhibit no very marked diagnostic characters, but the edible, shore, and masked crabs are common, the two former between tide-marks, the latter in the inshore sand, along with *Portunus variegatus* and *Portunus holsatus*. The northern stone-crab is not uncommon in the deeper water. *Mysis* is abundant and *Borcophausia* and *Nyctiphanes* occasionally in great profusion in the inshore water, along with *Parathemisto*.

The Lepraliæ and Alcyonidians are fairly numerous between tide-marks. In the adjoining sea the most characteristic are *Bugula purpurea* and *Flustra Murrayana* with the larval *Cyphonautes*.

Of shell-fishes the mussel is the most conspicuous, along with *Mya arenaria* and the cockle on the beach, whilst between tide-marks amongst the rocks *Trochus cinerarius* and *Tapes pullastra* are characteristic. Only a single rock-oyster is occasionally met with. In the pelagic fauna mussels are likewise the most prominent in summer. The pteropods *Spirialis* and *Clione* also occur, the former often in great numbers, the latter a pigmy in comparison with the arctic examples.

Ascidians, with the exception of *Styela rustica*, are not common between tide-marks; but in the adjoining waters *Ascidia scabra* is abundant on the tangles. In the deeper water *Molgula* occurs, and, in certain areas, the remarkable *Pelonaia*. Myriads of the pelagic Appendicularians fill the tow-nets.

The fishes between tide-marks are those usually observed all along the coasts, viz. shannies, gunnels, long-spined sea-scorpions, gobies, fifteen-spined sticklebacks, and sand-eels, while the flatfishes and thorn-backs are characteristic of the margin of the sandy bay beyond. Soles are occasionally procured. The ordinary round fishes are abundant, but the conger is less common than on the west and south. The characteristic young fishes at the margin of the rocks in summer and autumn are young green cod, cod, ling, lump-suckers, and sand-eels, with pleuronectids, herrings, and gunnels in the adjoining area.

The marine mammals include the seal—still present in

considerable numbers at the mouths of such salmon-rivers as the Tay—and a few porpoises. The rorqual and lesser rorqual are occasionally seen, and also scattered pairs of the ca'ing whale. Killers are rare.

Turning now to the extreme west, to shores more or less influenced by warm currents both of air and water, the first feature of note is the comparatively small rise and fall of each tide, and, in bays like Lochmaddy, the great abundance of mud; but it must not be thought that the latter is absent from the eastern shores, for a great deposit occurs east of the Island of May and at many other parts of the coast. Before proceeding to the consideration of the fauna of the west, we may, indeed, glance briefly at this deposition of mud, a question which has often been before marine zoologists. Thus, during the 'Porcupine' Expedition of 1870 Dr. Carpenter broached the idea that the deposit of fine mud in the deeper parts of the basin of the Mediterranean was devoid of life because of the turbidity of the bottom-water. He held, indeed, that such fine particles diffused through the water would produce asphyxia in the marine animals. Further, he pointed out the bearing of his explanation in regard to the vast azoic deposits of the geologists. I showed at the time* that such a theory should only be built on well-ascertained facts, and, moreover, that, so far as my experience went, the facts were not favourable. For example, many littoral sponges are found on extremely muddy ground, while the siliceous sponges all over the world affect a muddy bottom. Muddy ground is the favourite haunt of zoophytes, sea-pens, and other Cœlenterates. Certain starfishes and *Synapta* are found only in mud. *Terebellæ* and *Gephyrea* in vast numbers are characteristic of muddy beaches; not only these, but many other annelids, are found nowhere else than amongst mud or muddy sand, and this is often of such a nature that the sea-water which covers them must always be loaded with minute particles, which may also coat the littoral sea-weeds. Some of the most delicate and beautiful of these annelids, with the finest branchial plumes, live amongst tenacious chalk-mud, yet they are so sensitive to other impurities that a very slight admixture of fresh water is instantly fatal. Those familiar with the habits of the shore-crab (*Carcinus maenas*) will be cautious in attributing a deleterious influence to mud of any description. Others of the higher crustaceans burrow in it. In muddy sand various mollusks live and thrive, such as *Scrobicularia*, *Corbula*, *Crenella*, and even an occasional oyster; while ascidians and mussels are not only powdered

* Ann. & Mag. Nat. Hist., January 1872, p. 10.

on their respective sites, but the latter are often almost imbedded in it. The witch (*Pleuronectes cynoglossus*) is partial to muddy ground, mud is the home of the hag-fish, and even the delicate young flounders, on descending after their pelagic existence and metamorphosis to the bottom, skim through and hide (all but the eyes) in it along our muddy shores. Referring to the tidal and adjoining area, the conclusion then (1871) was:—"In general, muddy ground is found to be much more productive in marine life of all kinds than where the rocks, sea-weeds, and sands are pure." The barrenness of such regions in the Mediterranean, therefore, was not proved to be due to the muddy character of the water *per se*. The greatly extended researches of a quarter of a century have only confirmed these opinions.

This question of the muddy deposits has again, and quite recently, been brought forward by Dr. John Murray, who, in the 'Challenger' publications*, established what he calls a mud-line, which he fixes everywhere at or about 100 fathoms. He considers this line the great feeding-ground of the ocean, citing, in proof, the capture of myriads of young and adult crustaceans, many of them phosphorescent, and nearly all of the red or brown colour characteristic of deep water. These, again, he says, furnish food for migratory fishes, such as the herring and the salmon†, while the stomachs of whales are crowded with cuttlefishes and crustaceans from considerable depths. His views were criticized last year by Prof. Herdman in his address to the Zoological Section of the British Association, and he differed so much as to hold that the deep-sea mud supports "a comparatively poor fauna as compared with other shallow-water deposits." He contrasts the hauls of small trawls in shallow water with those of the 'Challenger' in the deep-sea mud, and shows that the number of species and genera is greater in the former. It must be borne in mind, however, that some of the finest fishing-grounds are those in muddy areas, which abound in marine life of all kinds. The selection of more or less pelagic crustaceans as the test of the correctness of Dr. Murray's theory appears to be of doubtful import, though the latter himself is perhaps responsible for it. Such forms often fill the tow-nets over pure sand, or in midwater or near the surface far from mud. They are, indeed, found in great numbers under very diverse circumstances. The more minute, however,

* 'Deep-sea Deposits,' p. 184 *et seq.*, 1891; Summary, vol. ii. p. 1433, 1895.

† It would be interesting to give in detail the food of the salmon in the offshore waters.

frequently occur in swarms just over the muddy ground of certain fishing-banks, in the midst of multitudes of post-larval fishes which feed on them. But muddy ground is to be tested as much by the forms which live in it and on it as by those which, it may be, are only temporarily above it. From rhizopods to fishes there is no scarcity. Dr. Murray is inclined to think that "in the present period and not very remote geological past" his mud-line has played an important part in the spread of marine animals. Prof. Herdman, on the other hand, considers that the fauna of the Laminarian region is richer than that of the mud-line, and that there life "is most abundant, growth most active, competition most severe," that "evolution of new forms by natural selection has been most active," and that "migrations have taken place downwards to the abysses, outwards over the surface, and upwards on to the shore." Both the able naturalists just mentioned have doubtless good grounds for their views, so that the one theory may be as good as the other. It is doubtful, however, if we are yet in a position to speak decisively as to how and whence marine life radiated, either in the present or in the past.

Returning to the condition of the marine fauna on the extreme west, it is found that, instead of the soberly tinted sponges of the east, bright yellows and purples are met with, while the firm rounded *Geodia* grows on stones between tide-marks. The crumb-of-bread sponge, again, is partial to tangle-roots and stems, while *Grantia ciliata* abounds near low-water mark.

Foremost amongst the Coelenterates is the stony coral (*Caryophyllia Smithii*), which studs the hard gneiss stones near low-water mark, especially where, piled on each other, they form little caverns, in which the corals hang, grow upright, or project horizontally. Equally characteristic in certain creeks is *Anthea cereus*, which has a brownish or ash-coloured body and long large tentacles of greenish and magenta. Truly arborescent in habit, it is found only on the blades of the *Fuci* and tangles, though a few float freely with the very mobile disk uppermost and the long trailing tentacles hanging in the water. Indeed, it loosens hold of its site more readily than most of the group, and its tissues are comparatively delicate, so that when tearing tangle-blades, to separate them, the rent sometimes severs the anemone as well as the tangle. No sight could be more beautiful than to glance along the surging sea-weeds and watch the large tentacles with their hues of green and red nodding with each wave. Instead of *Ulva multicornis*

of the east we have the tufted *Clava squamata* on the littoral *Fuci*. One of the characteristic zoophytes is *Sertularia operculata*, which grows in dense tufts on the stems of the tangles. The Siphonophore, *Diphyes* (or *Muggicea*), occurs in the inshore waters, moving towards the surface with lively jerks, and dragging its trailing hydrosome with the orange polypites behind it, through a maze of the rich blue *Pelagia* and the pale or milky *Salpæ*. The abundance of *Veleva* is another striking feature of the region, and, indeed, of the western coast-line generally, while the rarer *Physalia* occasionally is met with in fine condition. *Funiculina* for the most part takes the place of *Pennatula*.

In the creeks and bays the rosy feather-star (*Antedon*), in both pale and dark red varieties, is abundant, clinging by its dorsal arms to the tangles, and moving with considerable rapidity. Between tide-marks *Asterias Mülleri* is occasionally procured; while Ophiuroids and two species of *Synapta* abound in the mud, viz. *Synapta Gallienni* and a new species (*S. tenera*), found nearly simultaneously with Canon Norman, who got his examples in Shetland, and the symmetry and beauty of the anchor-plates of which are diagnostic.

Several rare Nemerteans, such as *Tetrastemma Robertianæ* and *Carinella linearis*, occur between tide-marks; and of characteristic Annelids *Spinther*, *Lepidonotus clava*, *Nephtys Hombergii*, the richly tinted and lively *Ophiodromus vittatus*, *Alyrianida* with its long chain of bright orange buds, *Nereis Dumerilii*, *Owenia filiformis*, *Travisia Forbesii*, and *Trichobranchus glacialis*. The western shores of England produce the rare *Achloë astericola* and *Panthalis Ærstedii*, the latter, however, extending to Shetland; also a wealth of *Terebella*, especially *Terebella nebulosa*, Mont., with its commensal *Polynoë scolopendrina*, which here attains a much larger size than in the Channel Islands.

A prominent feature near low-water mark is the comparative abundance of the armed tubes of *Pomatocerus triquetus*, a Serpulid which covers the under surface of the hard gneiss boulders and wounds the fingers by the sharp anterior spine.

The most noteworthy crustacean is the large purple swimming-crab (*Portunus puber*), which is frequently found under the broad blades of the tangles in some of the creeks (as at Armaddy); and though its carapace is considerably thinner, it is as active in movement and fierce in defence as the shore-crab. Yet it has little of the hardihood of the latter, none surviving a night's confinement in a moist vasculum. *Spheroma* is common in the fissures of the gneiss rocks, and rolls itself into a ball—head to tail—when inter-

ferred with. Its back is speckled brown and white, while the border of each segment is reddish. The eyes are prominent, large, and black. When crawling it presents a strange appearance indeed, as if it had a crinoline.

The occurrence of pigmy forests of *Crisia eburnea* under stones between tide-marks instead of the zoophyte *Sertularia pumila* at St. Andrews forms a contrast, as also is the frequency of *Retepora Beaniana* in the deeper water.

The abundance of borers in wood and the comparative absence of borers in rocks is another marked feature. The only examples of rock-borers lurked between stones that had been fixed by a Laminarian root, in the interstices of the latter on rocks, and in peat, never in an independent tunnel in the rocks. The drift-wood is almost universally perforated by the ship-worm (*Teredo norvegica* and *T. megotara*), and since his barren country compels the islander to depend on such for almost every available purpose to which wood is applied, the investigator may well be conversant with the labours of these shell-fishes. Other notable bivalves between tide-marks are *Tapes decussata*, *Arca tetragona*, and *Pecten varius* var. *nivea*, while the frequency of oysters fixed to stones is characteristic. *Lima hians*, so often met with in the Clyde area, is absent, the rarer *Lima subauriculata* alone being procured by the dredge. The valves of *Pecten maximus* cast ashore by storms are still used for skimming milk and scooping butter*.

Between tide-marks *Trochus zizyphinus* in fine condition abounds at the verge of low water, hanging on the blades of the *Fuci*, but it is not so often met with in dredging as *T. cinerarius*. *Trochus umbilicatus* is rather less common than at Tobermory and other parts on the west coast, but it is not rare between tide-marks. All these places, however, differ materially from St. Andrews, where *Trochus cinerarius* is the only one met with in the same region. *Doris proxima* is often seen on the floating blades of the *Fuci* at low water. The prevalence of *Fissurella* and *Emarginula* between tide-marks, of the *Rissoæ*, *Akera bullata*, and *Phasianella* in the inshore waters, and of the pelagic *Ianthina* with its peculiar float, is noteworthy.

No greater contrast to the eastern shores exists in any group than in the Ascidians. On the latter only the compound forms and a few solitary ones under stones occur between tide-marks; here in the tidal region are large compound forms, such as *Aplidium*, *Amouroucium*, bright orange *Leptoclini*, *Botryllus*, and *Botrylloides*, and numerous solitary

* Further south, as at Southport, *Ceratisolen legumen* is diagnostic.

Ascidians stud the blades of the *Fuci* and tangles at low water, while very large species grow in the quiet parts of the inland seas. Other interesting forms are *Clavelina*, *Cynthia echinata*, *C. (Forbesella) tessellata*, and *Molgula*. Moreover, the surrounding seas occasionally swarm with Salpæ, both solitary and in the remarkable chains. So far as known no Salpæ have hitherto been found on the north-eastern shores, and such, at any rate, like the occurrence of the Physophores, must be very rare. In the offshore waters of the west *Doliolum* is now and then captured, and thus the west and the south agree in this respect.

In the department of fishes the contrast is sufficiently marked. Thus in the loch salmon and salmon-trout frequently leap above the surface close inshore. Young wrasses swim in shoals at the margin of the rocks, or lurk under the sea-weeds of the rock-pools. Bimaculated suckers are prevalent in the Laminarian region, and green cod and conger are more abundant than on the east.

Of the marine mammals seals are much more numerous than on the east, the headquarters of this species being in the Sound of Harris. A few great grey seals haunt the rocks at Hashkeir. Finners and porpoises are likewise more frequently observed, and the same may be said of the killer (*Orca*).

When we come to the extreme north of Scotland, viz., the Shetland Islands, we encounter a very rich marine fauna—not so much between tide-marks as in the voes and in the deep water beyond.

A wealth of large sponges, including perhaps the “grandest” British sponge (*Phakellia ventilabrum*), is diagnostic. Besides the foregoing another cup-sponge (*Isodyctia infundibuliformis*) is common, and this region is also the home of the remarkable turnip-sponge (*Oceanapia Jeffreysii*, Bow.), with branched processes of considerable length growing from both poles of the sphere, while the interior, into which those fistulæ pass, is filled with sarcode, to the extent, as its discoverer, Canon Norman, says, of nearly a pint. The interesting *Geodia zetlandica* and the yellow sea-apple (*Tethea cranium*) are also present.

Of the Coelenterates between tide-marks the abundance of *Coryne pusilla* and *Gonothyrea*, and of *Tubularia indivisa* with *T. larynx* parasitic on it at low water, merit notice, both of the latter being characteristic of the deeper water in the east and west. Between tide-marks also the anemones *Actinoloba dianthus* and *Corynactis viridis* are found; while *Corymorpha* occurs in the sandy voes. Moreover, in the latter and in the sounds in July immense numbers of a

Beroë (*Idyia cucumis*) swim amidst swarms of *Arachnactis albida* of Sars, a pelagic stage of an anemone (*Cerianthus*), and they are also sometimes accompanied by *Diphyes* and *Physophora*.

In the off-shore waters, again, we have the zoophyte *Aglaophenia*, a genus characteristically southern. Of anemones *Bolocera eques*, *B. Tuedia*, *Stomphia*, and *Adamsia* occur, all, however, passing further south along the east coast. The stony corals are more characteristic, such as *Caryophyllia Smithii*, var. *borealis*, and, in small numbers, *Paracyathus* and *Ulocyathus*. *Epizoanthus* appears to be almost typical and in great profusion, one form (*E. incrustans*) being inhabited by a hermit-crab.

The characteristic Echinoderms are two species of rosy feather-star in considerable numbers, *Asterias glacialis* and *Asterias Mülleri*, the latter being only met with in deep water, whereas at St. Andrews it occurs between tide-marks. The sea-urchins are represented by the piper (*Cidaris papillata*), *Echinus Flemingii*, *E. norvegicus*, *Toxopneustes pictus*, *Brissopsis lyrifera*, and a specially southern form *Spatangus meridionalis* of Risso. Of Holothurians or sea-cucumbers, one of the most striking is *Cucumaria frondosa*, which has been familiar to zoologists since the days of Edward Forbes, but *Thyonidium hyalinum* and species of the genus *Thyone* are also common.

Amongst the Annelids are the rare *Eurythoe borealis* of Sars, swarms of a small sea-mouse (*Laetmatonice filicornis*), the northern *Eunoea nodosa*, Sars, *Sthenelais Buskii* (found nowhere else), *Panthalis Örstedii*, *Nothria conchylega* in abundance, *Eumenia Jeffreysii*, *Trophonia glauca*, *Rhodine Lovéni*, *Axiothea catenata*, *Ampharete arctica*, *Amphicteis Gunneri*, *Pista cristata*, *Trichobranchus glacialis*, and *Euchone analis*. The remarkable *Polygordius* is in great profusion amongst the coarse gravelly bottom formed of *Melobesia*. There are likewise some peculiar Nemerteans, such as *Amphiporus hastatus*, *A. bioculatus*, *Meckelia asulcata*, and *Valencinia lineiformis*.

Of the Crustaceans, *Pagurus tuberculatus*, Risso, and *Xantho rivulosus*, Risso—both Mediterranean forms,—*Pagurus tricarminatus*, *Crangon serratus*, and *Lophogaster typicus* (Stomatopoda) are noteworthy*. As a rule the remarkable forms lean to northern types.

Amongst the Polyzoa the free growths of *Cellepora*, and the occurrence of such species as *Flustra Barleei* and *Hornera*, are interesting.

The Brachiopods are frequently met with.

* For these and some other references I am indebted to the late Dr. Gwyn Jeffreys's and Canon Norman's papers.

The most noteworthy bivalve mollusks are *Pinna rudis*, *Isocardia cor*, *Solecurtus*, *Pandora inæquivalvis*, *Siphonodentalium*, and *Cadulus*.

Amongst the univalves it is difficult to give forms specially Zetlandic, though species of *Odostomia*, *Trochus helycinus*, *T. grænlandicus*, and *Trichotropis borealis* are very abundant amongst the tangle-roots. The list includes *Puncturella noachina*, *Aporrhais Macandree*, Jeff., *Columbella haliweti*, *Lyonsia*, *Lepeta*, *Trochus amabilis*, the *Jeffreysia*, *Pleurotoma nivalis*, *Scaphander librarius*, *Philine angulata*, *P. nitida*, and *Rossia papillifera*. A large number are common to the Mediterranean.

Of the Hemichordates perhaps the most characteristic is *Rhabdopleura Normanni*, Allman, which has not been found in any other area in Britain.

The Urochordates (Tunicates) are represented by an occasional example of *Pelonaia*, a form only got in profusion in our own neighbourhood, and by great numbers of ascidians, chiefly of a common type.

Salpa runcinata, Chamisso, again, is now and then met with in the tow-nets, with *Diphyes* and *Physophora*, as well as a few Appendicularians.

Amongst fishes one of the most characteristic is the torsk (*Brosmius brosme*), which is nowhere (in Britain) met with in greater numbers or of larger size. Cod, haddock, and green cod are of large size and abundant, and large pollack are more common than in the south. Conger, again, are especially numerous on the western shores. *Chimæra* is not uncommon. The large size of many of the forms—both elasmobranch and teleostean—is in contrast with the eastern and southern fish-fauna.

Of mammals the most conspicuous are the finners and the ca'ing whales (*Globiocephalus melas*), but small numbers of rarer forms, such as *Mesoplodon*, are occasionally met with. Porpoises are often remarkably numerous, but seals are less common than in the Outer Hebrides.

In considering the relations of this our most northern area with the arctic fauna, some remarks of Dr. Murray's in the last volume of the 'Challenger' summary may here be noticed. He says * :—"In polar waters a marked peculiarity of the tow-net gatherings is the almost total absence of pelagic larvæ belonging to benthonic organisms, and we know that many of the Echinoderms and other shallow-water animals of the Arctic and Antarctic regions are furnished with pouches in which the young are reared; the same appears to be true of the animals living about and deeper than the mud-

* Summary of Results, vol. ii. p. 1459.

line in all parts of the world. In temperate zones, where there is a wide range in annual temperature, the pelagic larvæ of benthonic animals appear only in the spring and summer seasons; in the tropics they are present at all times in the surface-waters. If there were once a nearly universal climate over the whole ocean, we may suppose that the same species of benthonic animals were nearly everywhere present in the shallow-water zones. When cooling at the poles set in, those animals with pelagic larvæ would be killed out or be forced to migrate towards the warmer tropics. By being able to limit the reproductive process to the summer season, some of these organisms with free-swimming larvæ have been able to live on in the temperate regions, but in the tropical and coral-reef regions we have the remnants of a once universally distributed shallow-water fauna. With the disappearance of this shallow-water fauna from the polar regions its place would be occupied by the organisms from the deeper mud-line, very few of which possess pelagic larvæ."

With respect to the first part of this quotation it is doubtful if the actual facts connected with the polar fauna bear out this interpretation. In the first place, well-known deep-sea (or, as he calls them, benthonic) arctic animals have pelagic larvæ, such as sponges, zoophytes, star-fishes, and annelids. The condition of the latter alone would prove fatal to the argument. Further, the mere examination of surface-organisms in the tow-nets is no proof that swarms of pelagic larvæ do not exist near the bottom. The pelagic larvæ of the pteropods and hydromedusæ that abound in the "whale-food," and the pelagic eggs and larvæ of fishes, would be quite as likely to suffer as the ciliated young of the benthonic forms previously mentioned. Again, while it is true that certain polar forms have hollows or pouches in which the young are reared, the same holds good with *Asterias Müllerii* and *Cribrella sanguinolenta* of the tidal rocks, and the *Autolytus* of the inshore waters of St. Andrews. The number of these forms in the polar waters, moreover, is out of proportion to those which have no such provision, and in which the larvæ are free-swimming. So far as present knowledge goes the same remarks apply to "animals living about and deeper than the mud-line in all parts of the world."

Some modification is also necessary in regard to the statement that "In temperate zones . . . the pelagic larvæ of benthonic animals appear only in the spring and summer seasons," whereas "in the tropics they are present at all times at the surface." Now in climates like our own it is well known that delicate pelagic forms like ciliated larvæ prefer the surface only in mild and calm weather, but their

absence from the surface is no proof that they are not in the lower regions of the water. Rough or, in winter, cold weather generally causes even adult pelagic forms to seek the lower regions of the water, and it is unlikely that delicate larvæ would be less sensitive. If in temperate regions it should happen that these mild, calm days were frequent throughout the year, such organisms would appear in the surface-waters during a considerable part of the year, if not throughout it, since from January to December pelagic larval forms (benthonic) of one kind or other are present. It is true the numbers of such forms would constitute a spindle with the bulky region in the warmer months, but, nevertheless, a considerable number occur in what are called the colder months.

It is thus doubtful how far we can accept this theory, viz., that the "cooling at the poles killed off the animals with pelagic larvæ or forced them to migrate to the warmer tropics." Considerably stronger evidence is yet required before we can assert that towards the poles deep-sea animals have no pelagic larvæ.

In surveying the tidal fauna of the Channel Islands, such as Guernsey, Herm, and Sark, one of the most prominent features is the abundance of the Protozoan *Noctiluca*, which here and in the south of England causes the sea to be brilliantly phosphorescent, whereas, so far as known, it never occurs in the northern part of Britain, the phosphorescent *Ceratium* there taking its place. The ravages of the boring-sponge (*Hymeniacidon celata*) are everywhere visible in the oyster-beds in the inshore waters, and especially in the beautiful arborescent patterns in many of the dead bivalves and limpets on the shell-beach at Herm. The same form affects the calcareous rocks on the southern shores of England.

Of zoophytes the most noteworthy are *Aglaophenia pluma* and *A. pennatula*, and the presence of *Tubularia indivisa* in the Gouliot Caves of Sark at low water. Yet we have seen that this likewise occurs occasionally in Shetland.

Between tide-marks the gaudily-striped *Sagartia parasitica* is carried about on shells inhabited by hermit-crabs, while in the deeper water the richly-tinted *Adamsia palliata* is common on shells inhabited by *Eupagurus Prideauxii*.

Rosy feather-stars are frequent between tide-marks, as are also fine examples of the bluish or purplish *Asterias glacialis*, and in the adjoining area are the purple, Flemings's, and the silky-spined urchins, together with *Synapta Gallienni*. In no other area is there such a combination.

In the same way richly-coloured Planarians like *Eurylepta vittata*, and Nemerteans such as *Borlasia Elisabethæ*, *Drepa-*

nophorus, and the viviparous *Proserochnus*, are characteristic. The Euphrosynidæ amongst Annelids have their headquarters as tidal forms in this region. Instead of the northern seamice (*Aphrodite* and *Lætmatonice*), we have in abundance the southern *Hermione hystrix*, with its naked scales and long barbed spines, in water from 10 to 20 fathoms. The occurrence of *Harmothoë areolata*, Grube, *H. marphysæ*, of the *Nereis* (*Eulalia*) *nebulosa* of Montagu, of *Nereis Marionii* and the general prominence of Nereids, of the Eunicidæ, Lumbriconereidæ, *Staurocephalus*, *Chaetopterus*, *Sabellaria alveolata*, *Lepræa* and other Terebellids, *Sabella saxicava*, and *Protula* and *Filigrana* between tide-marks, are diagnostic.

In no group is the contrast greater than in the higher crustacea. The huge spiny lobster off rocky shores, velvet-crabs, *Pirimela* and *Ebalia* under stones between tide-marks, *Alpheus ruber* and *Pagurus cuanensis* in rock-pools, *Pagurus Prideauxii*, *Maia*, *Dromia*, and *Polybius* are all more or less characteristic. In the same way the presence of *Cymodocea truncata* and *Sphæroma Prideauxianum* in the fissures of rocks between tide-marks and *Dynamene* in rock-pools, the large *Cymothoa* on fishes, and other sessile-eyed crustaceans are noteworthy.

The extraordinary beauty and profusion of the Polyzoa, such as the Escharidæ and the Lepraliæ, between tide-marks, together with the finely spiral tufts of *Bugula turbinata* and the free growth of *Amathia lendigera* and *Flustra chartracea* (the two last from the inshore water), are also southern features, as also is the occurrence of *Argiope*.

The molluscan fauna is characterized by the presence of extensive beds of large oysters in the inshore waters, with the somewhat rare borer, *Gastrochæna*, perforating the upper valve of many; whilst amongst them are large *Anomia*. Other typical species are *Mactra glauca*, *Triton nodifer*, *T. montacuti*, *Cardium papillosum*, and *Murex aciculatus*.

Between tide-marks we have *Pecten varius*, *Mytilus barbatus*, *Arca tetragona*, and *Galcomma Turtoni*, a lamelli-branch which opens its valves and adheres to the under surface of stones. Only here does *Haliotis* (the ear-shell or "ormer") occur between tide-marks; and in the rock-pools no sight can be more striking than to watch *Lima* nimbly moving through the water with its bright orange tentacles forming an ornamental fringe. *Trochus lineatus*, *Murex erinaceus* and *M. aciculatus*, *Aplysia*, *Cerithium*, and *Cerithiopsis* are likewise characteristic of the tidal area, and *Calyptrea* of the adjoining waters, along with numerous *Octopi*, which have their homes under the larger stones.

Balanoglossus is found between tide-marks, and ascidians are numerous and large in the same region. In the surrounding waters swarms of *Salpæ* occasionally appear, now and then accompanied by *Doliolum*.

Amongst fishes, eels are abundant between tide-marks, and wrasses at the margin of the rocks, gliding here and there like dark shadows under the tangles. Black gobies are frequent in the tidal region; while in the inshore waters whiting-pout, red mullets, *Hippocampi*, gattoruginous blennies, rainbow, cook, and other wrasses, *Serranus*, small blue sharks and congers, are common. "Schools" of pilchards break the surface of the water like a heavy shower of hail in certain areas, and mackerel are abundant.

The marine mammals, viz. seals and cetaceans, are much less common than in the north and north-west.

Each of the four areas has certain forms common to all, but at the same time each has species that occur sparingly or not at all in the others, though it is true great caution is required in regard to the latter statement.

The eastern coast is distinguished rather by the absence of forms that are present in other areas, though the abundance of such as *Lucernaria*, *Hippasterias*, *Echiurus*, *Magelona*, *Pelonaia*, and the remarkably persistent profusion of food-fishes are also features of moment. Towards the north, as in the Moray Frith, again, we encounter southern forms that show no connecting links along the eastern shores, but the distribution of which seems to point to the view of Canon Norman that such may have travelled from the west round the north of Scotland, or in some cases may have passed from the northern shores of Europe in a westerly direction.

The western coast is in the main southern in its fauna, though the abundance of *Caryophyllia* and *Pomatocerus triquetus* within tide-marks, and of *Verella*, *Ianthina*, and the *Salpæ*, together with the frequency of seals and whales, are distinguishing features. The invertebrate marine fauna and fishes may have spread from the south and the west.

That the warm currents of air and water along the western shores are the main factors in accounting for the special fauna of the region is evident, and they carry that fauna to the Shetland Islands, and, passing through the various gaps, lave both sides of the land, so that the eastern fauna of the latter more resembles that of the west. Thus the southern types like *Adamsia*, that are found in the Moray Frith, may have spread from the same centres, though the commingling of northern species (for example, *Lumpenus*) proves that other centres along the northern shores of Europe must have contributed.

Contrasted with other regions, the richness of Shetland in cup-, apple-, and turnip-sponges, its swarms of *Arachnactis albida* and *Echinus norvegicus*, the occurrence of *Cidaris papillata*, the huge *Cucumaria frondosa*, *Eurythoe borealis*, *Læmatonice*, the Ampharetidæ, the peculiar mollusca, the large size and frequency of the torsk, the presence of *Chimæra* and its many Cetaceans, give it characters of its own. The majority of these appear to have come from the north and east. Forms, again, which occur in deep water in Shetland appear between tide-marks in the Channel Islands, and occasionally in diminished bulk. The presence of Mediterranean forms—*Xantho rivulosus*, *Pagurus tuberculatus*, and *Pinna rudis*—show how difficult it is to explain the centres of origin or the lines of migration.

Boldly mapping out the warmer southern area is the distribution of *Noctiluca*, of the silky-spined urchins, the brightly coloured *Eurylepta*, and *Drepanophorus* amongst Nemerteans, of the southern sea-mouse (*Hermione*), of the crustaceans *Alpheus*, the spiny lobster, *Polybius* and *Dromia*, the mollusks *Gastrochaena*, *Galeomma*, *Mactra glauca*, *Haliotis*, and the frequency of the cuttles between tide-marks, of *Balanoglossus*, the finely coloured wrasses, the red mullets, and the pilchards. Almost all these forms are essentially southern, and they show no stragglers leading northwards, such having probably been checked more by the diminished annual temperature than by the absence of favourable currents.

In conclusion, limited as the area we have been considering is, it is apparent that while some forms are common to all, certain restraining influences check the spread of others, so that they become more or less characteristic of the several regions. Moreover, the mixed nature of the fauna shows that we have to do with several sources of origin, some of which date back to geological periods marked by a different arrangement of the land, and a consequent change in the temperature of the water.

LX.—On Excretory Organs and Sexual Conditions in certain Isopoda. By BOHUMIL NEMEC, of Prague*.

IN the course of my investigations upon Isopods I have arrived at certain interesting results relating to their excretory and genital organs, of which I here furnish a short résumé.

* Translated by E. E. Austen from the 'Zoologischer Anzeiger,' Bd. xix. no. 507 (July 6, 1896), pp. 297-301.

The excretory organs characteristic of the majority of Crustacea, namely the antennary and shell-glands, are found in the Oniscodæ, which formed the greater part of my material for investigation, either greatly reduced or with altered functions, as has already been pointed out by Claus in the case of the Anisopoda.

The antennary gland forms a small glandular saccule at the base of the antennæ, which, however, is destitute of any efferent duct. In *Asellus* and *Ligidium* this saccule is of fairly large size and also possesses a distinct lumen. In the Oniscineæ, on the other hand, the homologous rudiment forms only a small solid mass of cells. Probably the saccule alluded to corresponds to the so-called terminal saccule ("Endsäckchen"), as it appears in homologous normally developed glands.

The shell-gland, which was found by Claus in *Asellus* and certain Oniscineæ, exhibits various conditions in Isopods. In *Asellus*, as stated by Claus, and as I was able to convince myself, it is enormously developed. In this case also it really represents an excretory organ. In Oniscodæ this gland is either reduced, as is especially the case in the Oniscineæ, or it has—in Hygrophileæ—experienced a change of function.

In *Ligidium*, *Haplophthalmus*, and *Trichoniscus* this gland appears as an organ of somewhat considerable size, which extends beneath the masticatory stomach right into the basal joints of the second pair of maxillæ and of the maxillipedes. In front there can be distinguished a thin-walled terminal saccule, leading into a long coiled canal which opens on the underside of the second pair of maxillæ. The epithelium of the coiled canal possesses a typical cortical striation, which is coarsely developed, particularly in *Haplophthalmus*. Exactly below the orifice the maxillipede exhibits a spoon-shaped excavation, and it is in this very cavity that the discharged secretion is collected. Sagittal longitudinal sections show quite clearly that the secretion which fills the cavity really comes from the shell-gland.

This collection of the evacuated secretion must surely have an object. Probably the secretion comes in some way into play in the process of feeding. This explanation is the more probable since otherwise no differentiated salivary glands occur in Oniscodæ, and, moreover, in the case of other Articulata excretory organs may enter into close relationship to the ingestion of food.

The very organ that functions as a salivary gland in the Hygrophileæ referred to appears greatly reduced in the

Oniscineæ (*Porcellio*, *Platyarthrus*). In *Platyarthrus* it appears to be altogether devoid of an excretory duct. A distinct terminal sacculus can with difficulty be made out. The gland, which is greatly pressed towards the ventral side, consists of a curved and relatively simple sac, of which the epithelial wall—just as in the *Hygrophileæ*—represents a syncytium. In the plasma two well-marked layers can be distinguished. The lower one, in which also lie the nuclei, is finely granular; that which clothes the lumen is clear and finely striated.

Besides urinary deposits in the fat-body, as has been described by Weber in *Trichoniscus*, we find in Oniscodeæ peculiar excretory organs lying in the last three thoracic and in the three to five abdominal segments. In the fourth segment there lies to the side of the abdominal ganglion a large gland, which opens upon the fifth segment (really almost intersegmentally between the fourth and fifth segments). This glandular sac, which in forms provided with pigment is surrounded by a pigmented sheath of connective tissue, is formed for the most part of large cells, and its broad lumen is filled with a finely granular secretion. The organ appears to be of ectodermal origin.

The glands of the two following segments are thin-walled sacs lying in the region of the lateral blood-lacunæ, and their epithelium consists of well-differentiated cells. The lumen of these glands is filled with a secretion similar to that of the gland of the fourth segment. In respect of these organs the *Hygrophileæ* differ from the Oniscineæ in that in the former the two pairs of glands alluded to lie freely in the connective tissue, without efferent ducts and surrounded by lateral blood-lacunæ. In Oniscineæ a fine efferent duct runs from the usually irregularly lobed glands, and opens beneath the epimerite in front of the legs of the sixth and seventh segments. In *Hygrophileæ*, however, the glands take the shape of closed sacs, the interior of which is entirely filled with a homogeneous yellowish secretion. The phylogeny of these organs appears to me to be determined by the conditions found in *Haplophthalmus*, where, besides the large segmental sacs, we meet with small sacculi precisely similar to the large ones and lying irregularly distributed in the connective tissue in the region of the blood-lacunæ.

This appears to me to be the original condition of the organs in question. In the connective tissue were deposited—as happens in an intracellular manner in the pericardial tissue—intercellular urinary substances, certain of which developed into large sacs, which finally were enabled to discharge their

secretion to the exterior by means of an excretory duct of secondary origin.

In the first three abdominal segments (*Porcellio*)—in *Ligidium*, in all probability in the two following ones also—I found coiled and ramifying canals, which send out efferent ducts towards the bases of the several branchial opercula. The canals in question again are situated in the region of those blood-lacunæ in which the blood from the branchiæ streams up into the pericardium. If these tubes really function as excretory organs their difference in form and structure from the excretory organs of the last thoracic segments may be explained by the fact that in this case it is oxydized blood that is dealt with, while, on the other hand, the former excretory organs are washed by venous blood.

In the case of *Asellus* urinary deposits in the fat-body have already been recognized by Leydig in what are known as Zenker's glands. These glands are distinguishable with the naked eye as being composed of separate globules, each of which represents a single cell, and these cells may attain a size of as much as 8 millim. Their plasma is entirely obliterated by spherical concretions. But these cells still exhibit a large nucleus, provided with nuclear reticulum and chromatin granules, which appears to be for the most part pressed flat and much emarginated. Consequently we are here dealing not with a mechanical deposition of secreted substances, but with a vital energetic activity of certain specified cells of the connective tissue.

I shall publish elsewhere a detailed description of the sexual organs of Isopods. I will here only allude to certain phenomena which are correlated with hermaphroditism.

The oviducts in Oniscodæ open, as is well known, upon the fifth segment. The distal portion of the oviduct secretes the receptacula seminis, discovered by Schöbl, as hollow chitinous structures or as solid styles. It is manifest that this portion is of ectodermal origin, as is also proved by its embryology. Now, I found in males of *Platyarthrus* in the fifth thoracic segment the same structure which in immature females represents the rudiment of the distal section of the oviduct. This consists of a blind tube projecting into the body-cavity, which in young males is filled with a solid style of chitin, but in older ones with a hollow blind chitinous cylinder that is undoubtedly homologous with the female receptaculum. We must regard this as an hermaphrodite structure. As regards internal sexual organs I searched in vain for phenomena which could be connected with the condition in question. On the other hand, I directed my

attention to rudimentary appendages upon the first two abdominal segments in the female, which Schöbl had already designated rudimentary male copulatory organs, an interpretation with which I entirely concur.

It is a well-known fact that a remarkable sexual difference occurs in Isopods with reference to the size of the adults. In *Platyarthrus* the males appear considerably smaller than the females. They exhibit on the whole characters belonging to immature females, and this applies especially to the size of the brain; for in both sexes up to a certain stage the brain grows at the same rate. Adult males have a brain of precisely the same size as that of immature females of about the same dimensions. The female continues to grow, but the brain undergoes no further increase in size, so that it finally comes to lie in a large cephalic cavity; while in the males, on the contrary, the cephalic cavity is entirely filled by the brain. It would be quite a plausible view to suppose that at one time all individuals attained to male sexual maturity at a stage at which they had not yet reached their definitive size. After fulfilling their sexual function as males they continued to grow and developed into sexually mature females. In the stage of male sexual maturity the brain was very large; it still entirely filled the cephalic cavity, while the oviducts were present only in the form of blind invaginations of the hypodermis, as is yet the case in sexually mature males at the present time.

A successive hermaphroditism of this kind, however, proved to be not advantageous, and in consequence of this there ensued a separation of the sexes. Certain individuals remained stationary at the stage of male sexual maturity, in consequence of which they remind us of immature individuals: the rudiments of the oviducts, too, have persisted in them. Other individuals grew on directly into females, since in these there has been a cænogenetic cessation of the appearance of male sexual organs. As remnants of a male maturity which formerly appeared in them these individuals possess rudiments of male copulatory organs.

In *Platyarthrus* accordingly proterandrous hermaphroditism at one time occurred. In other Isopods it may perhaps have been proterogynous. This was the case in *Sphaeroma rugicauda*, for instance, in the internal sexual organs of which Leichmann discovered what were undoubtedly hermaphrodite rudiments. This author observes also that all young specimens exhibit the general appearance of females, which in the case of certain individuals is not exchanged for the definitive masculine form until shortly before the attainment of male

sexual maturity. He also describes an individual which, though internally it exhibited fully developed male sexual organs, as far as its exterior was concerned bore quite the character of a female, even possessing, indeed, rudiments of brood-lamellæ.

I incline towards the view that Isopods were originally altogether hermaphrodite. Such conditions, however, persisted only in parasitic forms (Cymothoidæ), for which hermaphroditism must be universally advantageous. In the case of free-living forms this state of affairs disappeared. In them we find that only scattered and scanty hermaphrodite remnants or rudiments are preserved.

LXI.—*A new Genus of Aglossal Batrachians.*

By G. A. BOULENGER, F.R.S.

AMONG the rich herpetological collections made by Stuhlmann in East Africa the frog described by Tornier as *Xenopus Boettgeri* (Thierw. Ost-Afr., Rept. Amph. p. 163, fig., 1896) is of exceptional interest in adding a second genus to the Dactylethridæ. As Tornier has not realized the systematic importance of the characters which differentiate the new species from *Xenopus levis* and its allies, it is thought desirable to emphasize it by raising *Xenopus Boettgeri* to generic rank under the name of *Hymenochirus Boettgeri*. The principal characters that distinguish *Hymenochirus* from *Xenopus* are, so far as can be judged from Tornier's description and figure, the half-webbed fingers, the incompletely webbed toes, the third of which considerably exceeds the fourth in length, and, above all, the absence of lines of sensory muciferous canals on the body. No doubt a careful examination of the type specimen, unfortunately still unique, would reveal further differences, and the Röntgen rays might be usefully applied to obtain some information on the osteological characters.

LXII.—*Descriptions of Two new Frogs obtained in Madagascar by Dr. Forsyth Major.* By G. A. BOULENGER, F.R.S.

Mantidactylus Majori.

Closely allied to *M. curtus*, Blgr., but snout much longer, acutely pointed, and very strongly projecting beyond the mouth. Vomerine teeth in two small, oblique, oval groups close together behind the level of the choanæ. Head longer

than broad, flat above, sides nearly vertical; snout as long as the diameter of the orbit, with sharp canthus and feebly grooved lores; nostril midway between the eye and the tip of the snout; interorbital space nearly as broad as the upper eyelid; tympanum very distinct, three fourths the diameter of the eye. First finger considerably shorter than second; toes webbed to the disks, with small subarticular tubercles; inner metatarsal tubercle small, oval, scarcely prominent, measuring about one fourth the length of the inner toe; disks of fingers and toes small but well developed. The tibio-tarsal articulation reaches the eye or between the eye and the nostril. Skin finely shagreened above, with scattered very small warts; smooth beneath; femoral glands present, not punctured (♀). Dark grey-brown above, with whitish dots and indistinct darker blotches; a fine light vertebral line; limbs with indistinct dark bars; hinder side of thighs dark brown, mottled with white; flanks and lower parts white; throat mottled with greyish brown.

From snout to vent 47 millim.

Two female specimens from Ivohimanita.

Rhacophorus Peracca.

Vomerine teeth in two slightly oblique oval groups just behind the level of the choanæ. Head as long as broad; snout rounded, not projecting, as long as the diameter of the orbit; canthus rostralis obtuse; loreal region concave; nostril midway between the eye and the end of the snout; interorbital space as broad as the upper eyelid; tympanum distinct, half the diameter of the eye. Fingers with rudimentary web, first much shorter than second; disks large, as large as the tympanum. Toes half-webbed, with smaller disks and small subarticular tubercles; two small metatarsal tubercles, inner oval, outer round; no tarsal fold. Tibio-tarsal articulation reaching the nostril. Head and back with small smooth warts; a fold above the tympanum; limbs and throat smooth; belly and lower surface of thighs granular. Pale brown above, with dark brown, light-edged insuliform spots; these form a cross on the head, the horizontal branches on the upper eyelids, and regular bars on the limbs. Lower parts white, with a few brown dots on the breast and under the thighs.

From snout to vent 33 millim.

A single specimen from Ivohimanita.

Named after my friend Count M. Peracca, who has added much to our knowledge of the Batrachian fauna of Madagascar.

LXIII.—*On the Reproduction of the Tripylean Radiolaria (Phæodaria).* By Dr. A. BORGERT*.

DURING my sojourn this year at the Zoological Station at Naples there was afforded to me in the months from January to May the opportunity, vainly sought for in former years, of studying more closely the conditions of reproduction in the Phæodaria. The special subject of my investigations was *Aulacantha scolymantha*. In the case of this form I succeeded in observing direct as well as mitotic nuclear division and in following in detail the processes that take place therein.

In **direct nuclear division** we observe no gradual constriction, but rather a cleavage of the nucleus into two halves of approximately equal size. The cleft, which originally is quite narrow, grows broader in subsequent stages, and the two halves of the nucleus separate one from the other and become rounded off. These changes in the interior of the central capsule are accompanied by others which are external.

Thus we note the appearance of an annular shallow groove with sharply defined edges on the surface of the central capsule. This groove lies in the same plane as the cleft passing through the nucleus, *i. e.* vertically to the frontal plane †, and divides the main aperture. Instead of the single main aperture originally present two such apertures are formed. Between the edges of the groove the capsular membrane is very delicate. It therefore easily happens that in isolating a central capsule in process of division the two halves come apart in the groove. This is also the spot at which in binary fission the severance of the daughter capsules takes place. Each of these individuals has to supply a secondary aperture by new formation, since in the process of fission it receives only one. Certain figures published by R. Hertwig ‡ and Haeckel § undoubtedly refer to the direct mode of division. Similarly it is evident that Karawaiew ||, during his investigations upon *Aulacantha*, frequently ob-

* Translated by E. E. Austen from the 'Zoologischer Anzeiger,' Bd. xix. no. 507 (July 6, 1896), pp. 307-311.

† I follow the example of Haeckel in designating by the term "frontal" plane that in which are situated the three apertures of the central capsule.

‡ R. Hertwig, 'Der Organismus der Radiolarien,' 1879, Taf. ix. fig. 2, Taf. x. fig. 2.

§ E. Haeckel, "Report on the Radiolaria collected by H.M.S. 'Challenger' during the years 1873-1876," 'Challenger' Reports, Zoology, vol. xviii. pl. ci. fig. 2.

|| W. Karawaiew, "Beobachtungen über die Structur und Vermehrung von *Aulacantha scolymantha*, Haeckel," Zool. Anz. Bd. xviii. (1895) pp. 286-289 and 293-301.

served specimens that were engaged in direct division. Nevertheless he appears erroneously to have regarded them as later stages of indirect nuclear division.

The occurrence of **mitotic nuclear division** in *Aulacantha* was first established by Karawaiew, who, however, observed only a portion of the entire series of stages.

In the resting nucleus the arrangement of the chromatin resembles a coarse sponge. When the nucleus is preparing to divide the framework gradually becomes finer and finer, until at last there is formed in the cavity of the nucleus the characteristic ball of thread. The thread is very fine and extraordinarily closely coiled, so that one is unable to say whether the ball consists of a single long thread or of several such threads. At a later stage the ball presents a looser appearance, and at this period a longitudinal cleavage of the chromatin thread takes place. Thus far we have been able to follow Karawaiew's series of pro-phrases ("Prophasen").

As a closer investigation teaches us, the thread in the stage last described consists of a number of sections (chromosomes), after the longitudinal cleavage of which a complete separation of the daughter threads is effected. Now, after the disappearance of the nuclear membrane also the segments of the nucleus arrange themselves in the shape of a plate, which passes from the main aperture towards the opposite side, and so divides the contents of the central capsule into two parts. At the same time the plate does not lie in one plane, but is warped, so that in a certain position its edges form a figure in the shape of an 8. Individual differences moreover prevail with respect to the amount of the twisting. At this stage another longitudinal cleavage of the segments takes place, whereby the division of the equatorial plate into the two daughter plates is ushered in. On the completion of this process also the daughter plates move further apart, at the same time becoming transformed into parallel plane disks somewhat smaller in diameter.

Since Karawaiew also observed this stage, but has not described the structure of the plates properly, I must dwell on it for a moment.

According to Karawaiew each plate is formed of "two different substances." "The bulk consists of a relatively feebly stainable substance, which, on the surface of the plates that is turned towards the centre, projects into the endoplasm in the form of numerous finger-shaped outgrowths; the surface directed towards the periphery is smooth. This larger portion of the plates is permeated by numerous transverse threads, which consist of rows of extremely small

globules, and take a deep stain with safranin; these threads consequently exhibit the property of chromatin."

The sections that I have prepared have led me to a different interpretation, according to which the plates consist of numerous segments of unequal length lying very close together. The finger-shaped outgrowths of a relatively feebly stainable substance, which Karawaiew describes, can only be the ends of the chromatin threads which project further.

Moreover, I am unable to confirm the presence of "two cleft-shaped cavities on the outer surface of the daughter plates," which are said to be "separated from the plasma by a thin and somewhat less transparent layer," and to be filled with nuclear fluid. I would add that, by using a suitable method of fixing, at this stage in the non-vacuolate plasma lying between the plates I was able to observe a fine striation running from one side to the other, and, further, that in somewhat more advanced stages the future plane of severance is to be found already indicated halfway between the plates.

I will here pass lightly over the further processes leading to the reconstruction of the daughter nuclei. They consist in the plates becoming bent, each with the concave side towards the other plate, so that each of them assumes the shape of a bowl. Then they gradually become more and more rounded off, until finally even the last small depression disappears. The further changes in the structure of the daughter nuclei, which, as also the mother nucleus, exhibit a fine membrane, represent a retrograde recapitulation of the first pro-phase stages. The arrangement of the chromatin in the shape of a thread, which still remains distinctly visible for some time, especially in the outer layer of the nuclei, at last gives way to the spongy disposition characteristic of the resting condition of the nucleus of *Aulacantha*.

After the daughter plates have already become transformed into cup-shaped structures, we recognize on the exterior of the central capsule the first indications of the constriction which now commences. This is announced by the appearance on the aboral side of a slight groove, which, running vertically to the frontal plane, gradually advances further and further, and finally divides the central capsule into the two daughter capsules. Thus, in opposition to what we find in direct division, binary fission of the main aperture does not set in until a relatively late period.

I would remark, further, that no trace of a nuclear spindle and centrosomes could be discovered.

Besides the nuclear stages already alluded to we find others that fit into none of the developmental series discussed above,

but rather, from a certain point onwards, seem to constitute a series of their own.

At a particular stage the nucleus of *Aulacantha* sometimes exhibits a pronounced cordate shape. The tip is directed towards the oral pole, while the notch is situated opposite to it on the aboral side. At the latter spot there arises an invagination into the interior of the nucleus, which, though at first small, continually increases in size. When the internal cavity has attained somewhat larger dimensions, on rotating the central capsule through 90° on its main axis we observe, besides other changes, before all things, a constriction on the oral side of the nucleus. At a more advanced stage the groove has increased in depth, while we notice that the internal cavity is divided into two parts by a septum extending from the oral towards the aboral side. The septum is not simple, but double, and the groove penetrates between its two walls.

There can be no doubt that it is in this plane that the division of the nucleus is effected. Owing to the cavity in their interior the daughter nuclei, on the separation of the halves, possess a shape similar to that exhibited at a certain stage in their development by the nuclei formed by division of the equatorial plate. The finer structure, too, exhibits many points of agreement, since in both cases the chromatin is disposed in threads.

Sometimes, and that not altogether seldom, stages in nuclear division are observed that present an entirely different appearance. In these cases apparently the object aimed at is not attained. Since they do not admit of being ranged under any precise method, I believe that their origin is to be ascribed to a miscarriage of division.

Karawaiew has already alluded to the fact that the division of the central capsule of an individual is not under all circumstances immediately followed by a distribution of the rest of the component parts of the body among the two daughter individuals, but that through repeated division of the daughter capsules the formation of a kind of colony may result. The greatest number of the central capsules met with under such circumstances amounted to five. I recently found a particularly large specimen with as many as eight central capsules.

It still remains for us to refer briefly to a few other stages. In examining our material we now and again meet with specimens in whose central capsule we fail to find the nucleus. Instead, on the application of staining reagents for nuclei the entire contents of the central capsule take a slight stain. A closer study of prepared sections shows that in such cases the

whole of the chromatin of the nucleus has become distributed in the plasma. I have acquired a continuous series of developmental stages right up to the complete dispersion of the chromatin. Later on one finds the cavity of the skeleton filled with numerous multinucleate globules. It is evident that the process leads to the formation of swarm-spores.

Again, other individuals are sometimes met with in which in place of the nucleus there is found a vesicle with a considerably thickened wall that takes a deep stain with hæmatoxylin or carmine. This wall is clothed on the inside with a coat of protoplasm. The most striking feature in these stages consists, however, in the presence of many larger and smaller globules, which, on being treated with osmium or mixtures containing osmium, become black, and seem to consist essentially of fat. They lie arranged in a hollow cup ("Kugelschale") against the inner wall. In other cases we meet with similar structures outside the nucleus in the endoplasm. Sometimes there are only one or two such vesicles, at other times a larger number, even amounting to as many as twelve or more. On their appearance the nucleus undergoes certain changes—indeed, it may even entirely cease to exist as such; in the endoplasm, too, degenerative phenomena take place.

Since it was no part of my plan, in framing the foregoing remarks, to propound far-reaching conclusions and comparisons, I have confined myself to putting together in simple form the most essential observations. In so doing I have touched very briefly even upon the most important points. My detailed paper, which will appear shortly, contains all further particulars.

BIBLIOGRAPHICAL NOTICE.

The Collector's Manual of British Land and Freshwater Shells. By LIONEL ERNEST ADAMS, B.A. Second Edition. 8vo. Leeds, 1896.

A NEW edition of this work will probably be welcomed by many collectors of British land and freshwater shells, as it contains instructions with regard to collecting, the means to be employed, the localities to be searched, the methods of preparing specimens for the cabinet, and remarks upon labelling, mounting, and arrangement of collections, which may be useful to them. By the more scientific student, however, the book will be less appreciated, as some portions of the classification adopted are very archaic, and mistakes have crept in, so that a want of thoroughness seems to pervade the

volume. The classification followed is that which appeared in 'The Conchological Society's List of British Land and Freshwater Mollusca, 1892.'

The author in the preface observes that "it is to be regretted that, of necessity, many of the old familiar names—almost household words that call up so many associations—have to give way to others by the inexorable law of priority; but it is to be hoped that the present system of nomenclature is now fairly crystallized." If our author admits the law of priority, he need scarcely regret altering "old familiar names"; but, if he really imagines that the nomenclature he has employed is at all final, we are afraid that his mind will soon be disabused of so vain a hope. For example, we would point out that (1) the genus *Neritina* (p. 13) belongs to the Scutibranchiata, and not to the Pectinibranchiata; (2) that *Cyclostoma* (why not *Pomatias* if priority is to be observed?) is not classified with the Pulmonata; (3) that the terms (p. 147) Acephala, Pelecypoda, and Lamellibranchiata, respectively termed class, subclass, and order, are practically synonymous. On p. 19 the Pulmonata is regarded as a *suborder* of Inoperculata, which is termed an *order* of Gastropoda (!), whereas on p. 137 it is placed as a *suborder* of Operculata. Mr. Adams, whilst adopting the genus *Vivipara* (Montfort used the masculine form *Viviparus*) instead of *Paludina* of Lamarck, has still retained the family name Paludiniæ, a course which is not permissible. The generic nomenclature also needs much revision. *Vitrina* scarcely requires a family Vitrinidæ, but might have been left in Limacidæ. *Hyalinia* of Agassiz is not synonymous with *Zonites* of De Montfort, and is posterior to *Vitrea* of Fitzinger. The "Helices" are arranged in thirteen subgenera, some of which, e. g. *Patula*, *Punctum*, *Acanthinula*, and *Vallonia*, are now regarded as distinct genera, and others fall under the genus *Helicella*; *Chilotrema* is synonymous with *Helicigona*, Férussac, *Goniostoma* (preoccupied) with *Helicodonta*, and *Turricula*, Beck (also preoccupied) with *Trochulus* of Schlüter. With regard to specific names*, we would point out that, whilst adopting *Helix itala*, Linn., in place of *H. cinctorum*, Müller, it is remarkable that the *Helix barbara*, Linn. (synonymous with *H. acuta*, Müll., *fide* Hanley, Westerlund, and Pilsbry), is wholly disregarded. Mr. Adams, like most British conchologists, makes very free use of varietal names, a course which has on several occasions been severely deprecated. For our own part, however, we consider that, within certain limits, the use of varietal names is undoubtedly convenient, and it is the abuse and not the use of the system which has led to censure. In the descriptions, which are mostly very brief, the surface-sculpture is very often totally disregarded. For instance, the peculiar wrinkling of *Helix aspersa* and the spiral striae of *H. arbustorum* and the oblique lines of growth in many are not referred to. The glossary (pp. 164–181) will be useful to young students; but it is

* *Helix cantianiformis*, Ancey, from Folkestone (Bull. Soc. malac. France, 1884, p. 168), is not referred to.

unfortunate that some of the definitions are either inadequate or misleading, e. g., "*Gastropoda*, a class of univalve mollusks, the lower surface of whose belly forms the foot." Many Gastropods have no shells, and in some the foot (*Vermetus*, *Xenophora*, *Strombus*, &c.) cannot be said to form the lower surface of their belly. *Genus* is termed "a subdivision of an Order." This should be family. The explanations given of mantle, Pulmonobranchiata, scar, sinuate, suture, synonym, valve, &c. are extremely crude. A synonym is said to be "a name that has the same meaning as another name"; the suture is "the furrow between the whorls of a univalve"; muscular scars are described as "depressions formed by the attachment of the muscles holding the parts of a bivalve together."

In the index we notice that synonyms are omitted. This, in cases of such old "familiar names" as *Paludina*, *Helix ericetorum*, *Hyalinia Draparnaldi*, *H. glabra*, and *Pupa umbilicata*, is to be regretted.

In conclusion, whilst pointing out certain inaccuracies which mar the work, we do not altogether deny its utility, for, being written by an experienced field-naturalist, it contains much information that will be useful to the collector. The nine original plates are reproduced with slight alterations, and to them have been added two others devoted to slugs and *Pisidia*.

MISCELLANEOUS.

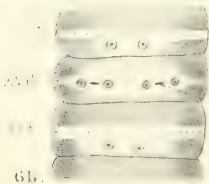
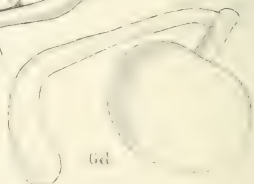
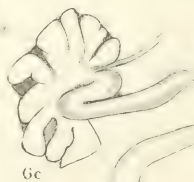
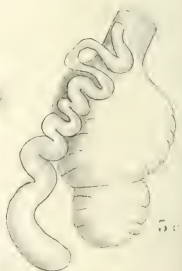
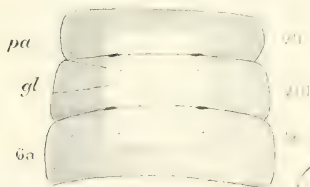
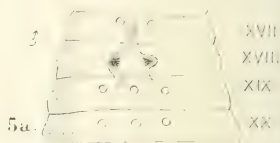
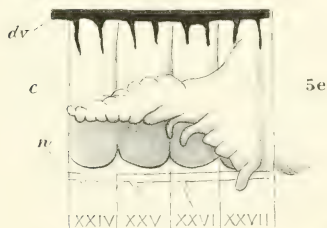
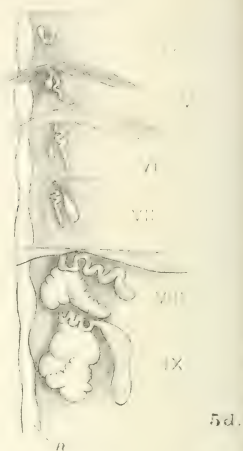
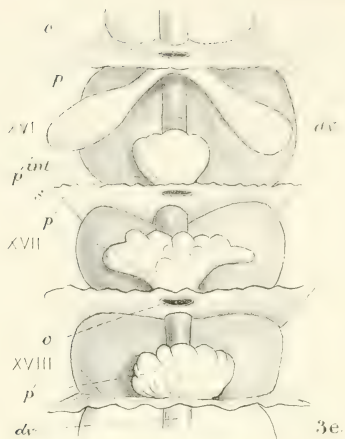
Lysactinic, not Lissactinic.

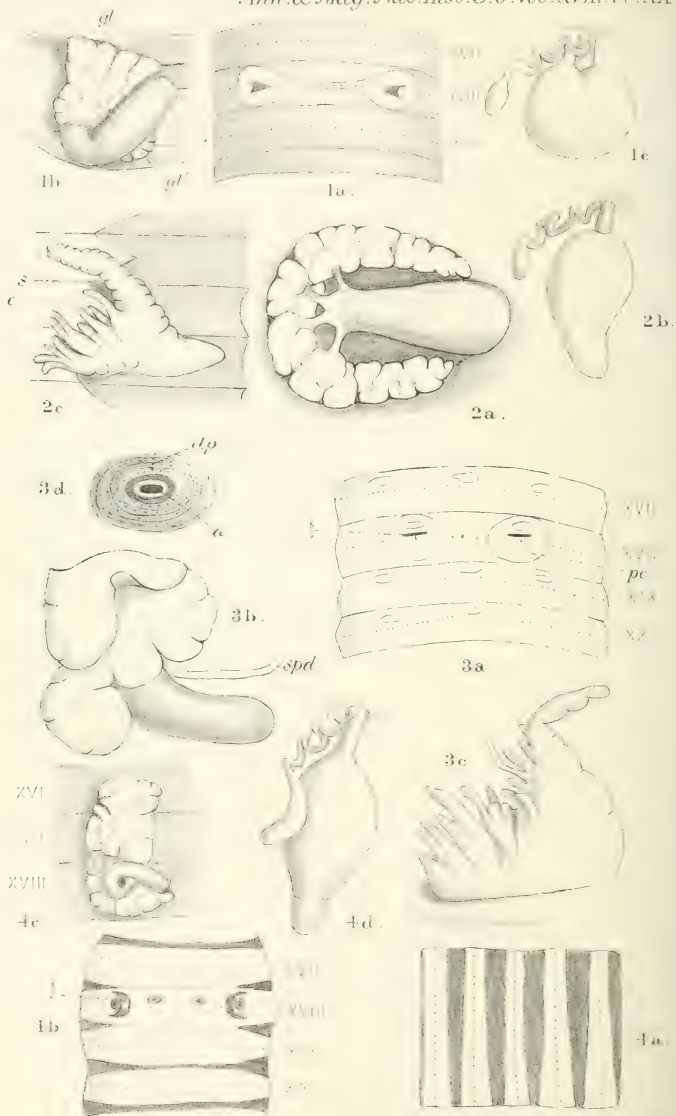
To the Editors of the 'Annals and Magazine of Natural History.'

GENTLEMEN,—Dr. Gregory has called my attention to a serious and misleading error on p. 14 of my 'Catalogue of British Echinoderms.' In line 12 there occurs in brackets the word *lissactinic*; as is clear from the corresponding word *desmactinic*, five lines lower, I meant to express in one word that condition of Echinoderm organization in which the rays are free from the "calycinal plates." Of course I ought to have written *lysactinic*.

I am totally at a loss to explain how I came to make such an egregious blunder, for it would be both an affectation and an untruth to appeal to the Johnsonian excuse of "sheer ignorance, madam," while the Horatian explanation of Homer's occasional sleepiness is altogether inapplicable: no schoolboy—I do not mean Lord Macaulay's prodigy—in the hottest, sleepest afternoon of all the summer half would ever be caught napping like this. I remember, however, that in the later part of the year 1891 I had my first attack of influenza, and the error was, perhaps, a sequela of that mysterious and enervating affliction.

F. JEFFREY BELL.





THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

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LXIV.—*Some Earthworms from Celebes.* By W. BLAXLAND BENHAM, D.Sc. (Lond.), Hon. M.A. (Oxon.), Aldrichian Demonstrator in Comparative Anatomy, Oxford.

[Plates XX. & XXI.]

ALTHOUGH a considerable number of species of the large genus *Perichæta* have been described from the Malay Archipelago by Horst, Rosa, Beddard, and myself, yet none have been collected, so far as I am aware, on the island of Celebes; at any rate, none are recorded in Beddard's monograph. I was therefore very glad to have the opportunity of examining a small collection from this island and from Jampea, due south of it, made by Mr. H. Everett and presented to the British Museum, and placed in my hands for identification by Prof. Bell, to whom my best thanks are due.

The twelve worms which form the collection fall into at least six groups, none of which agree with any species hitherto known. As so frequently happens, some of these new species are represented by one specimen.

For the more ready comparison with already existing species, I append to each description of the anatomy of the individual a summary of what I regard as the characteristic features, in the form of a diagnosis. Such a diagnosis is of no value till other specimens are found; but I have much felt

the absence of such a brief *résumé* in many instances whilst reading through the literature of the genus.

Perichæta jampeana, sp. n. (Pl. XX. fig. 1.)

Three specimens are included in this species.

The colour is a nearly uniform dark olive-green on the back; the chætal bands, so usually present in the genus, are here no lighter than the ground-colour. The worm is not perceptibly darker anteriorly. The dark colour extends well round on to the ventral surface, leaving a light stripe with a pinkish tint running along the middle third of the ventral surface; measured on the dissected specimen this stripe is 7 millim. broad, the circumference of the worm being 36 millim. But the anterior end of the body for about the first twenty-six segments does not present this light ventral band; here the dark greenish tint extends right round the body, over a very unusual number of segments, and the ventral surface is scarcely lighter than the back. One specimen was "mottled" on the upper surface with pinkish patches, some large, others small, irregular and varied in shape.

The clitellum is nearly black, though with a bluish tint.

The worm is, except in front of the clitellum, of about the same diameter throughout; the posterior end is very suddenly rounded, so as to appear almost truncate.

Two of the specimens measure 315×12 and 310×10 millim. respectively, and the former consists of 150 segments.

The *clitellum*, which occupies the normal three segments, is not swollen, presents a trace of the intersegmental grooves, but no chætæ.

The *male pores* are conspicuous as wide depressions in a pinkish circular area; the eighteenth segment has a pink dumb-bell-shaped area, with a slight papilla at each end; in this papilla is the pore itself: the outer lip is rounded and prominent, but not sharply marked; the inner lip scarcely exists, as the surface slopes down gradually to the pore.

Between the two pores are 13 or 14 chætæ (fig. 1 a).

It may be mentioned that the distance between the pores, as measured by compasses the points of which were placed in the pores, is 5, 6, and 8 millim. respectively, the last in a very soft specimen.

The *spermathecal pores* are between segments vii./viii., viii./ix., each in a small pinkish area; about 19 or 20 chætæ between pores.

There are no copulatory papillæ.

The *chætæ* form a complete circle, without any perceptible dorsal or ventral gap.

I counted on the body 70 *chætæ* on segment iii.

70	„	„	ix.
100	„	„	xxiv.

The first *dorsal pore* is between segments xii./xiii., though possibly it occurs earlier, as the worms are strongly contracted; in front of the clitellum it is impossible to see the pore.

The *internal anatomy* presents the usual characters of a "*Perichaeta*" (s. str.) as regards gizzard, septa, heart, and cæcum. The last, however, presents this peculiarity, that it is deeply notched externally, so that, in addition to the long main cæcum, some 11 or 12 secondary cæca arise from its base. (See the description of *P. digitata*.)

There are two pairs of *spermathecae* in segments viii. and ix.; each is a nearly spherical sac, with a short narrow duct, into which opens a long undulating diverticulum, slightly dilated terminally to form a somewhat oval sac (fig. 1 c). The anterior spermatheca on each side is about half the size of that in the ninth segment.

The *spermiducal gland* is relatively small; it is confined to segment xviii., though it pushes the posterior septum back nearly to the next septum. Roughly speaking, the gland is triangular when viewed from above, compact, only slightly notched (fig. 1 b). The duct, which is stout and short, runs alongside it in an obliquely longitudinal direction; but the gland itself really underlies the hinder part of the duct, so as to appear from below it on its mesial side.

I noted nothing else characteristic in the worm.

The comparatively large size of this worm allows only a few species to be compared with it, and of those occurring in the same region none appear to resemble it in colour. But I find that authors frequently omit a careful description of colour; and although Beddard has insisted on its importance, he himself, in recent papers (Monograph, and P. Z. S. 1895 and 1896), says little about it. As for structural characters, this worm approaches none of the other species closely. Most of the worms with two pairs of spermathecae in segments viii. and ix. are much smaller, and amongst the non-papillate species there are none that can be pointed to as like it in its totality of characters.

The diagnosis of the species is as follows:—

Dark olive-green; measuring 315 × 10 millim.; 150 segments.

Male pores large, at each end of dumb-bell-shaped

area; no copulatory papillæ. Spermathecæ in segments viii. and ix.; pores on anterior margins; a globular sac, with narrow (undulating) diverticulum, expanded terminally. Dorsal pore xii./xiii. Chætal ring complete, 70 chætæ in front of and 100 behind clitellum. Pair of cæca in xxvii., the base incised to form about 12 secondary cæca. Spermiducal gland small, triangular, confined to xviii.; duct thick, short, not curved; no muscular bulb.

Hab. Jampea Island, south of Celebes.

Perichæta digitata, sp. n. (Pl. XX. fig. 2.)

A single specimen serves for the foundation of this new species. It is rather smaller than the preceding, measuring 240×15 millim. at its thickest part.

It is rather pointed at each end, and especially at the tail, where the last dozen segments taper to a point; this difference may, of course, be due to preservation.

The general colour is lighter and of quite a different tone to that of the preceding, being a stony grey, with very slight greenish tint, and passing posteriorly into a distinct French grey. There is no banding, the chætal rings being no lighter than the rest; but the anterior part of the worm is lighter, not darker, as is almost universally the case, being much mottled with pinkish-white spots, irregular in arrangement and size, but all small. This mottling, which is a very unusual kind of marking in earthworms, diminishes behind the clitellum, the spots getting fewer and smaller, and ultimately ceasing.

The pigment does not extend so far down the sides as in the preceding worm, and the ventral surface of the anterior segments is light, this band being so wide as to take in the male and spermathecal pores. The ventral surface is generally a very light brown.

The clitellum is brown, but with an olive-green tint about it, and only slightly darker than the rest of the body.

The worm consists of 126 segments.

The *clitellum* is on the usual segments, but apparently not quite fully developed, as dorsal pores can be detected, and on the ventral surface of the segments xiv., xv., xvi. is a row of 18 or 20 chætæ. Whether these would be permanent must be left undecided.

The first *dorsal pore* is between segments xii./xiii.

The *male pores*, which are 6 millim. apart and are separated

by 14 chætæ, are wide deep pits with fairly well-marked lips, which are raised up and lighter in colour than the surrounding surface. Indeed, this region resembles that of *P. jampeana* if we imagine that that species had been much more contracted.

There are two pairs of *spermathecal pores*—between segments vii./viii., viii./ix.—at about the level of the seventh and eighth chætæ from the middle line.

The *chætæ* do not form quite a complete circle, as there is a dorsal gap behind the clitellum which, though subject to variations, is always greater than twice the normal interchætal gap. This dorsal gap is scarcely recognizable on the first six segments.

The ventral gap is smaller behind the clitellum, though distinct enough in front of it, where it is about twice the normal interchætal gap. Posteriorly it gets more nearly to equal this gap, and thus is not so readily recognizable.

The chætæ do not appear to be so closely set as in the preceding species. There are 30 chætæ on the left side in segment iii.; many had apparently dropped out on the right side, and the worm was too much hardened to remove the cuticle successfully. We may regard 60 as approximately the number on segment iii.

98 on segment vii.

100 „ xiii.

99 „ xx.

100 on a segment much further back.

It is worthy of note that the chætæ along the side are smaller and closer together than above or below.

Internal anatomy.—In addition to the thick septa round the pharynx, those between the following segments—x./xi., xi./xii., xii./xiii., xiii./xiv.—are very much thicker than the rest. Septum xiv./xv. is much thinner than these, but is thicker than the following ones.

Some stress, perhaps too much, has been laid upon the number of thickened septa, so that I have paid some attention to them in these worms; but, so far as my experience goes, they are not of importance as specific characters, though it is possible that they may characterize allied groups of species.

There is a trace of septum viii./ix.

The *gizzard* occupies segments viii. and ix.—that is to say that the space between the two septa vii./viii. and x./xi. is not wholly occupied by the gizzard, but a small part of the cesophagus equal to about the length of a segment intervenes between the gizzard and the septum x./xi.

The most striking and interesting as well as novel feature

about the alimentary system is presented by the conditions of the *cæcum*. It is usually stated that these pouches lie in the twenty-sixth segment. From an examination of my material I believe that they in reality belong to the twenty-seventh segment, but, being closely adpressed to the intestine in this segment and passing through the septum in front, so as to lie freely in segment xxvi., it appears at first sight that they belong to this latter segment. In the new species herein considered I carefully examined this point, and find that the *cæcum originates from the intestine in the twenty-seventh segment*; the communication is wide and occupies nearly all this segment.

In the present worm the *cæcum* is of considerable size; it rises by a broad base in the twenty-seventh segment, runs forward through the twenty-sixth, and extends to the anterior boundary of the twenty-fifth segment. Its wall is not entirely smooth, but along its dorsal (inner) and ventral (outer) side is notched, and these notches on the outer side become deeper as the base of the *cæcum* is approached, so as to produce secondary *cæca* or finger-shaped lobes. Of these one arises in the twenty-sixth segment close to the posterior septum, the rest arise in the twenty-seventh segment. There are about a dozen of these finger-shaped secondary *cæca*, arranged along the outer side of the base of the *cæcum* and tending to become smaller as the lower ventral surface of the gut is reached. Some of these secondary *cæca* arise as bifurcations of a simple lobe (as in figure 2 c).

Hitherto only a few species have been recorded in which more than a single pair of *cæca* are present, viz. *P. Hilgendorffi*, *P. Sieboldii*, *P. Gulielmi*, *P. mandhorensis*, and occasionally in *P. musica*, and in a new species of Beddard's—*P. trityphla*—from the Sandwich Islands. Probably in all these cases the mode of origin of these additional *cæca* is the same, as they are described as lying one above the other, to the number of three to six, according to the species; but in none are they so numerous as in the present species, hence the specific name "*digitata*."

The *vascular system* presents the following features:—

There are two pairs of latero-intestinal hearts in segments xii. and xiii., each being connected dorsally with the large dorsal trunk and the much smaller supra-intestinal vessel. In segment xi. there is an "intestinal heart" connected only with the supra-intestinal vessel. The dorsal vessel continues forward as a narrow tube above the gizzard, giving off a pair of vessels just anterior to the septum x./xi.; a second pair in front of the hinder margin of the gizzard; another

pair just in front of the septum vii./viii. Apparently there is no vessel in segment viii., nor are there any in segments xiv. and xv.; but posteriorly in and after segment xvi. the dorsal vessel gives off a pair of nearly vertical vessels to body-wall as well as two pairs to gut.

The dorsal vessel is provided with a pair of "glycogenic glands" on each of the posterior segments.

With regard to the generative organs, there are two pairs of *sperm-sacs* in segments xi. and xii., of relatively small size and of smooth surface. How these are related to "sperm-bladders" ("Samenblasen") I cannot say, as I did not wish to injure the specimen too much, and I do not consider this point of great importance.

Grape-like *ovisacs* of large size lie in segment xiv. continuous with large sac-like oviducts.

The *spermathecae* lie in segments viii. and ix., those of the eighth segment being about one fourth the size of the other pair. Each spermatheca consists of a somewhat pyriform sac with a long duct, into which opens an undulating diverticulum terminating in a slight dilatation (fig. 2 b).

This verbal description so closely resembles that given for *P. jampeana*, that one might easily imagine that the two species had the same shaped spermathecae; and it is a most important point, it seems to me, to illustrate these diagnostic organs in the *Perichæta*. A careful figure, to measurement for preference, will do more than many words of description to give an idea of the characters on which the species are founded. Many species of this difficult and extensive genus are known only from verbal descriptions, some of the terms employed being extremely "loose," and it is a matter of great difficulty to pick out the diagnostic characters of a species from a mere verbal description. Nevertheless, it must be borne in mind that the size and even shape of the main sac is liable to variation according to its state of repletion.

The same remarks apply to descriptions of the spermiducal gland: such terms as "compact," "loosish" in texture, unless accompanied by figures, are absolutely insufficient whereby to form a mental picture of the organ.

In the present species the *spermiducal gland* is entirely confined to the eighteenth segment and has a very characteristic form. It is arranged in the form of a horseshoe, the convexity outwards, embracing by its two limbs the thick straight duct. This duct passes at right angles to the long axis of the worm, then, after widening slightly, dips suddenly downwards, and runs under its former course, to gain the body-wall. There is no "muscular bulb." The gland appears

connected to the penial duct by three narrow delicate ducts, one from each limb and one from the bottom of the U-shaped gland (fig. 2 a).

I thought at first, seeing that there are several similarities between this and the preceding species, that the spermiducal gland might in reality be of the same shape, but in different positions, in the two worms. But I have been unable to place this gland in such a position as in the other worm so as to resemble it; further, there is no glandular substance below the duct such as there is in *P. jampeana*. The shape of this gland, in conjunction with the shape of the cæcum, is, indeed, very characteristic.

The difference in colour, in number of chætæ on the anterior segments, the existence of "gaps" in the circle of chætæ, the difference in the distance of the spermathecal pores from one another, in addition to the more conspicuous difference in the character of the spermiducal glands and of the spermathecæ, in these two worms from Jampea would seem to necessitate the formation of two species. Nevertheless for a long time I felt uncertain of the distinctness between them, since both agree in the peculiarity of the cæca, hitherto unrecorded, as well as in character of coloration, difference in size of the two spermathecæ on one side, &c., and I still hesitate as to whether this second worm may be only a variety of the species *P. jampeana*, for we know but very little as to the extent of "variation" in *Oligochæta*; but from facts derived from the study of other species in greater numbers, as well as from statements by Beddard, Rosa, and others, as to variations in structure in one and the same species, I think that it will be the better plan to form a separate species for it. Four worms are collected on an island, nearly the same in size and general anatomy, the points of difference being relatively small, the question arises—does it lead to less or to more confusion to give to each a new name, or to treat them as varieties of one species, till more specimens are known? If in the future it turns out that *P. digitata* is only a varietal form or an abnormality of *P. jampeana*, the name can be dropped.

The following is the diagnosis of the species:—

Stone-grey to French grey posteriorly; more or less mottled with lighter colour; measures 240×15 millim.; 126 or more segments. Male pores wide deep pits; no copulatory papillæ. Two pairs of spermathecæ in viii., ix., with anterior pores; pyriform sac, with long duct, receiving an undulating diverticulum, terminally dilated. Chætal ring with slight dorsal

and ventral gaps; about 100 chætæ, in front of and behind clitellum; chætæ smaller laterally. Dorsal pore xii./xiii. Paired cæca in xxvii., with about 12 secondary cæca arising from its base. Spermiducal gland horseshoe-shaped, embracing the wide, nearly straight duct; there is no muscular bulb.

Hab. Jampea Island, south of Celebes.

Perichæta bonthainensis, sp. n. (Pl. XX. fig. 3.)

One specimen only is referable to this species. It is about the same size as the last, but of quite a different colour. The posterior end is dilated, flattened, and as broad or even broader than the preclitellar region. One very noticeable feature about this end is the *large anus*, which is horizontal; so far as I can find recorded, this is quite peculiar. It may be suggested that the worm *may* have been compressed in packing; but there is no sign of that, and the outline of the anus is quite smooth and unpuckered, which would probably not be the case if a round anus had been compressed, perhaps irregularly or obliquely. Moreover, the anus is usually vertical in *Perichæta*. The anus is surrounded by a white, and this by a dark grey circle (fig. 3 d).

The colour of the worm is scarcely definable; it appears a good deal changed in spirit; one can only say that there is a bluish-grey narrow stripe along the back and rather lighter chætal bands; the general tone is lighter than in the preceding species. The first two segments, however, are violet. The clitellum is light brown and well marked, occupying the normal position, and is without chætæ. The ventral surface of the worm is buff.

The worm measures 280×17 millim. in front of clitellum; the diameter at the clitellum is 18 millim., and at the posterior end of the body 19 millim.; in middle of body only 13 millim.

The worm presents 107 segments.

Each *male pore* is a transverse slit or narrow depression on the top of a large round swollen area, lighter than the surrounding body. Each pore-bearing papilla or prominence occupies the whole length of the eighteenth segment, and carries immediately in front of the pore an oval area, which appears to be the remains of a glandular papilla (fig. 3 a).

Similar *areae* lie on segments xvii., xix., xx. In the two former segments there is a median and a pair of lateral papillæ slightly outside the line of the male pore. In the twentieth the papilla of the left side is wanting.

I am by no means certain that these oval areas are really the remains of copulatory papillæ; a careful examination with a hand-lens shows that the epidermis is here rubbed off and the circular muscles exposed. But since this abrasion has affected spots symmetrically arranged and of the same size and shape (roughly), and no other such spots occur on the worm, I believe that the glandular epithelium of papillæ projecting from these spots, and looser in character, has been rubbed away; I have therefore figured them as papillæ. The same remarks apply equally to those in front of the male pores. There are only three chætæ between the two "porophores"*, and it appears to me that there is one chæta in the centre of each, immediately behind the male pore; the existence of only three chætæ here is, I believe, unique; the pores are 5 millim. apart. The oviducal pore is median, as usual.

The *spermathecal pores* are not visible.

The first *dorsal pore* is xii./xiii.

The *chætæ* present a slight dorsal gap, equal to about twice the normal gap; this is visible behind, but not recognizable in front of the clitellum; there is a very slight but distinct ventral gap.

The chætæ on segments ii., iii. are distinctly *smaller* than those on the body generally, while those on segments iv., v., vi. are slightly larger.

On segment ii. there are about 50 chætæ, though occasional gaps equal to about 6 or 8 occur.

On segment iii., 92.

„ xiii., 125.

„ xxvi., 128 or 130.

Internal anatomy.—There are two pairs of *spermathecae*, in segments viii. and ix., with anteriorly placed openings. There is no perceptible difference in size between the pairs. The "sac" is oval, with a short thick duct, not well marked off from the sac. The diverticulum, dilated at the end, but of rather a different shape to that of the preceding species, has its duct less undulating.

The *spermiducal gland* is large, occupying segments xvi., xvii., xviii., and of rather a peculiar form. The anterior part of the gland is thicker than the rest, and the edge stands up above the rest (fig. 3 b). It is possible, of course, that the apparently peculiar shape of the gland may be due to strong contraction of the worm. It is only slightly notched, and

* I suggest this term for the slight papillæ on which, in nearly all earthworms, the male pore is situated.

may be spoken of as compact; it is relatively thick. The duct is short, straight, and thick.

The septa between segments x./xi., xi./xii., xii./xiii., xiii./xiv. are very stout; the next two are also moderately thick. The following septa are quite thin and present peculiar *pouchings* above the dorsal vessel (Pl. XXI. fig. 3 e).

The septum xvi./xvii. has on its anterior face a thin-walled sac lying in segment xvi.—that is, in the segment in front; this sac communicates by a wide opening with segment xvii.—that is, with the segment behind the septum. Each sac is slightly lobed or sacculated, and contains, but is not filled by, a coagulum. Each of the following septa has a similar pouch upon it. Segment xvi. also contains, attached to its anterior septum, two long pyriform sacs, which are, on further examination, seen to be due to the bifurcation of a single pouch which communicates with the anterior segment, *i. e.* segment xv.

Beddard has described in *Acanthodrilus falclandicus* a somewhat similar condition, and in his Monograph groups these pouches of the septa with the solid structures attached to septa of *Perichæta indica*, and with other structures occurring at the sides of the dorsal vessels in certain other species, *e. g.* *P. Dyeri*.

The vascular system shows no differences from that described above.

The cæcum is notched and digitate to the same extent as in *P. digitata*, but the secondary cæca are more irregular in size, shape, and mode of origin (Pl. XX. fig. 3 c).

The close approximation of the male pores recalls the most striking external generic character of *Perionyx*; but it is not quite unique in the genus *Perichæta*, since it occurs also in *P. violacea*, from which the present species differs in the number of spermathecæ. There can be no doubt that *P. jampeana*, *P. digitata*, and *P. bonthainensis* are very closely allied—a fact evidenced alike by the size, notable amongst *Perichætes*, and the extensive digitation of the cæcum.

The species may be diagnosed as follows:—

Bluish grey (?); measures 250 × 17 millim.; 107 segments.

Male pores as transverse slits on prominent rounded area, embracing elongated oval papilla in front of the pore. Three papillæ symmetrically arranged in a row in front of the chætæ on each of the segments xvii., xix., xx. Only three chætæ between the porophores. Two pairs of spermathecæ in viii., ix., opening anteriorly; sac ovate, short duct receiving an undulated

narrow diverticulum, dilated terminally; slight gaps in the ring of chætæ, which number about 90 in front of and 130 behind the clitellum, those on iv., v., vi. larger, and those on ii., iii. smaller, than on other segments. Dorsal pore xii./xiii. Paired cæca in xxvii. with secondary cæca. Spermiducal gland compact, ear-shaped, occupies segments xvi., xvii., xviii., not much incised, with thick nearly straight duct; no muscular bulb.

Hab. Bonthain Peak, Celebes.

Perichæta hexatheca, sp. n. (Pl. XXI. fig. 5.)

This species, again, is represented by a single specimen. It is pale brown, with white rings at the level of the chætæ. In the post-clitellar region there is a brown band running along the mid-dorsal line. The sides are pale and semi-transparent.

The worm measures 130×8 millim. and consists of 74 segments.

The *clitellum* is well marked, darker brown, with three whitish bands, but without chætæ.

Owing to the contraction of the ventral surface the *male pores* are brought close together and are separated by a fairly deep furrow, the bottom of which presents longitudinal folds of the cuticle (? of the body-wall as well). This furrow runs across segments xvii., xviii., and reminds one of the condition sometimes presented by Acanthodrilids. Each pore is small and rounded (fig. 5 a).

There are 8 *copulatory papillæ*, arranged as follows:—3 in a row on segment xx., 3 on xix., and 2 on xvii. It is possible that a median one exists here, but owing to the infolding of the wall I could see none; they are all situated in front of the chætal ring.

The *spermathecal pores*, of which there are *six pairs*, can scarcely be discerned externally; they lie in the grooves in front of the fourth to ninth segments, close to the middle line, about ten chætæ from one to the other.

The first *dorsal pore* is xii./xiii.

The *chætæ* form a complete ring. I was unable to pull the cuticle off in order to count the chætæ in the second segment. On the worm itself I counted 70 on segment vi., 80 or more on segment xiii., and more than 100 behind the clitellum; they are very small.

Internally, attention may be directed to the *cæcum*, arising

on segment xxvii., notched, as in the two preceding species, but with only three or four well-defined secondary cæca; and the lower part of base is traversed by furrows, indicating several other lobes.

There are six pairs of *spermathecae*, but of these only the last two pairs in segments viii. and ix. are readily seen; in fact, I overlooked the four anterior pairs at first (fig. 5 d).

The sac of the last two pairs is very irregular in shape, shrunk, and notched, but apparently each is normally constricted about one third from the apex and marked with circular rings; the diverticulum is longer than the sac—or, at any rate, as long as it, for the diverticula varied on the two sides;—the duct is in the form of a zigzag, and is dilated terminally (fig. 5 c). The spermatheca in segment ix. is about half as long as the gizzard, that in segment viii. about half as large as that in segment ix.

The anterior four pairs are all very much smaller and diminish in size from behind forwards; in the case of the two pairs in segments v. and vi. the diverticulum is much larger than the sac, which is pyriform; in segment iv. there is only one structure, apparently the sac. This is very minute, can only be seen under a dissecting-lens, and is readily torn from the body; but I found it on both sides, and thus am in no doubt as to its being a real structure.

I can recall no species either with so many as six pairs of spermathecae or in which such a difference in size between first and last occurs.

The *sperm-sacs* in segments xi. and xii. are lobulated; there are two *ovisacs* on each side in segments xiii. and xiv.

The *spermiducal gland* is unusually "compact" and relatively small (fig. 5 b). It consists essentially of three partially superposed long narrow lobes, with their longer axes at right angles to the axis of the body. The anterior lobe is highest when the worm is pinned out—that is, it is inmost in the natural position and pressed against the side of the intestine, so as to be concave on this surface. The other lobes project from below one another, as in the figure. The duct is slightly curved, lies transversely with concavity forwards. There is no muscular bulb.

Remarks.—Seeing that the first spermatheca is extremely small, probably vestigial, it occurred to me that perhaps this worm had already been described as one with five spermathecae. Beddard gives two species in this condition, viz.:—

P. violacea, which is much smaller and different in every way; and

P. pentacystis, which, though about the same size, has a

pair of genital papillæ on each of segments xvii., xviii.; the shape of the spermathecæ is different; whilst the number of chætæ, the character of the spermiducal glands, &c., differentiate it from the present species.

The species may be diagnosed as follows:—

Pale brown, with white chætal rings; median dorsal brown stripe; measures 130×8 millim.; 74 segments. Male pores small and round, separated by deep furrow (? artifact); 3 copulatory papillæ in xix., xx., and 2 (? 3) in xvii. Six pairs of spermathecæ, opening anteriorly in iv. to ix., the four anterior smaller than the other two; the sacs irregularly pyriform, with circular furrows and constrictions; short duct, receiving an undulating diverticulum, longer than sac, and gradually dilating terminally. Chætal ring complete, about 80 chætæ in front of and 100 behind the clitellum. Dorsal pore xii./xiii. Paired cæca in xxvii., incised to form four secondary cæca. Spermiducal gland small, three parallel lobes; duct curved forwards from the hinder end; no muscular sac.

Hab. Bonthain Peak, Celebes.

Perichæta zebra, sp. n. (Pl. XX. fig. 4.)

This is represented by one specimen, and is very conspicuously marked with alternate dark and light bands; the dark bands, looking black with the cuticle on, are really deep purplish brown; the light bands are nearly white, slightly yellowish.

Behind the clitellum the light band—chætal band—is about half the size of the intersegmental dark band; this band extends downwards at the side, and then rather suddenly narrows to cross the ventral surface as a very narrow strip; this ventral band is reddish brown in colour. The ventral surface of the eighteenth segment is light; the dark bands in front and behind do not pass beyond the male pores.

On the clitellum the banding is still present, but the light band is brown instead of yellowish white.

In front of the clitellum the dark bands are nearly black, and each is divided into two by a very narrow intersegmental lighter line, scarcely recognizable without a lens.

The first segment is entirely dark, having no light band.

The worm measures 200×6 millim. behind the clitellum; it consists of 120 segments; the posterior end is pointed.

The *male pores* are far apart, being separated by about 10

chætæ* ; each is a deep crescentic pit, with overhanging outer rounded lip (somewhat as in *P. capensis* and *P. operculata*). This carries a small cup-shaped papilla. From the bottom of the pit I can see a rounded tubercle projecting—the duct, no doubt, of the spermiducal gland. It is indicated on the left side of the figure.

Further, between the male pores on xviii., in front of chætæ, are two other cupped papillæ (“suckers”).

The oviducal pore is median.

There is a single pair of spermathecal pores between segments vii./viii., which, however, are not recognizable externally.

The clitellum presents no chætæ and occupies the normal position.

The first dorsal pore is xii./xiii.

There is no gap in the circle of chætæ, which are rather closer together ventrally, and number

On segment ii. 38.

„ vi. 62.

„ xiii. 68.

„ xxvi. 78.

Internal Anatomy.—There is only a single pair of spermathecae in segment viii.; the sac is characteristically shaped, being oval, but with the narrowed free end somewhat constricted off. The duct is fairly long; the diverticulum, not so long as the sac, is dilated distally and curved; its duct is slightly zigzag (fig. 4 d).

The sperm-sacs are large and rounded, in the usual segments.

The spermiducal gland is large and occupies three segments—xvi., xvii., xviii. It is roughly divided into two main lobes: one in xvi. and xvii. is nearly square; the other in xviii. is partially concealed by the duct; each lobe is incised, though not to a great extent (fig. 4 c). The duct is strongly curved after leaving the gland, rises up vertically, and then proceeds almost directly to the body-wall; there is no “muscular sac.”

In the normal position, when first opened, the duct extended laterally beyond the outer margin of the gland; in the figure it is represented as having been lifted up.

The cæcum, arising in segment xxvii., runs through xxvi. into xxv.; it is simple and not notched.

The diagnosis of the species is as follows:—

Alternate dark purple intersegmental and yellowish-white broad chaetal bands; measures 200 × 6 millim.; 120

* The lithographer has, in error, put 11 in the fig. 4 b.

segments. Male pores crescentic, far apart; outer lip rounded, overhanging the pore, with a small cup-shaped papilla at the tip; a pair of similar but larger papillæ on xviii. in front of the chætal ring. A single pair of spermathecæ in viii. with anterior pore; sac pyriform, with distinct duct, receiving undulating diverticulum with terminal sausage-shaped dilatation. Ring of chætæ without gaps; about 65 in front of and 78 behind clitellum. Dorsal pore xii./xiii. The cæcum in xxvii., simple. Spermiducal gland large, occupying xvi., xvii., xviii., in two lobes, each incised; long duct curved, without muscular sac (bulb).

Hab. Bonthain Peak, 6000 feet, Celebes.

Perichæta, sp. juv.

Two immature specimens were collected on Bonthain Peak; there is no trace of a clitellum.

In colour this species resembles the preceding worm and our "Brandling" *A. fætida*, that is, there are alternate bands of dark red-brown and yellow; but, as in other species of *Perichæta*, the light band is at the level of the chætæ; the dark bands are in the anterior segments subdivided by a narrow light intersegmental band. Behind the clitellum these dark bands are connected along the mid-dorsal line, so as to give the appearance of a dark line along the back. The coloured bands do not extend downwards beyond the "lateral line," *i. e.* halfway round the worm, so that the ventral surface is quite pale, with the exception of the three or four most anterior segments.

The worms measure respectively 84 and 90 millim.; the number of segments in the smaller worm is 133—that is, a larger number than in the larger species, *P. zebra*.

There is nothing noticeable about the male pores.

There is one pair of spermathecal pores, vii./viii.

The first dorsal pore is xii./xiii.

There is a distinct dorsal gap in the ring of chætæ, which number about the same as in *P. zebra*, *viz.*:—

62 on segment iv.

81 about " xx.

These are evidently young individuals, and I have not attempted to place them in a species, though in all probability they belong to *P. zebra*.

Perichæta purpurea, sp. n. (Pl. XXI. fig. 6.)

There are three specimens of this species. The colour of the worm is deep purple, with only very slightly lighter chætal bands, not recognizable anteriorly, so that this region appears continuously purple; the light bands are plain, but narrow, posteriorly, which is not lighter than the anterior end. The clitellum is of almost the same colour as the rest of the body. The dark bands become lighter on ventral surface, but can be seen to extend round the body.

The worms measure respectively 72, 90, and 95×5 millim.; the last worm consists of 116 segments.

The prostomium is embedded in one third of the first segment, and marked off by a transverse line from the latter.

The *male pores* are fairly distinct though small slits, not on a tumid papilla. There are five chætae between the pores (fig. 6 b).

This species is characterized by the number and arrangement of the copulatory papillæ. In segment xviii., both at the outer and at the inner end of each male pore, is a small pitted papilla. On segment xvii. there is a pair of similar but slightly larger papillæ just behind the chætal ring, in a line with the inner (mediad) papillæ of segment xviii. In segment xix. there is a similar pair of papillæ, similarly situated. There are thus eight papillæ, four on segment xviii. and two on each of the segments xvii. and xix. Further, there is a pair of papillæ on each of the segments viii. and ix., situated just behind the spermathecal pores and lying in front of the chætae of these segments.

There are two pairs of *spermathecal pores* between segments vii./viii., viii./ix., with about a dozen chætae between them.

These pores and the papillæ lie in a light brown glandular area, nearly square in shape, extending from the chætal ring on segment vii. to that on ix. (fig. 6 a).

The *oviducal pore* normal.

Clitellum normal, without chætae.

The first *dorsal pore* is xi./xii.

The *chætae* form a complete ring and number

34 on segment ii.

54 " vi.

70 " xiii.

70 " xxv.

Internal Anatomy.—None of the septa are noticeably thick, though those between segments x.xi., xi./xii. are rather stouter than the rest.

The gizzard has the usual bell-shape and lies in the usual

segments. The pair of cæca arise in segment xxvii., pass through segments xxvi. and xxv., and are constricted at the septa; each is a simple sac.

The sperm-sacs are in segments xi., xii., and were hidden by great quantities of gregarine and nematode cysts, which are definitely external to the sperm-sacs.

The *spermathecæ* are in segments viii. and ix.; the sac is globular, with a duct nearly half its length, and a diverticulum narrow, nearly straight, but strongly curved at its end, so as to resemble a golfing-club (fig. 6*d*). It is longer than the sac and its duct. The sac and diverticulum were very conspicuous, owing to the white contents; when teased, the sac was found to contain, as usual, granular coagulated substance; the spermatozoa are confined to the diverticulum, and in the enlarged terminal region are definitely arranged, all the heads being densely packed against the wall, with the tails towards the centre. It seemed to me that the heads of the spermatozoa are different from those of *Lumbricus* in being pointed and curved and shorter. In the duct of the diverticulum the spermatozoa are quite loosely and irregularly arranged, and it appears as if they were making their way upwards into the dilatation, where they will be probably attracted by some chemotaxic property of the epithelial cells, which secrete a fluid to bind them together in a kind of spermatophore.

The *spermiducal gland* is relatively small, and deeply lobed in a somewhat fan-shaped fashion; the duct is long, sharply bent upon itself soon after leaving the gland, and then running nearly directly to the body-wall (fig. 6*e*).

The structure of the copulatory papillæ could not be properly studied owing to the imperfect preservation of the worm; but each consists essentially of clitellar cells, the epidermis becoming suddenly thickened to about three times the usual depth; there is also a good deal of cellular tissue developed amongst the circular muscles, reminding one of the histological condition of the "capsulogenous glands" of the common earthworm.

This species may be diagnosed as follows:—

Deep purple; not banded; measures 70–95 × 5 millim.; 116 segments. Male pores slit-like, not on a papilla; separated by 5 chætæ. There is a cup-shaped papilla laterad and mediad of each pore. A pair of similar papillæ on xvii. and xix. behind the chætal ring. Two pairs of spermathecæ in viii. and ix., open anteriorly; pores conspicuous; each of these segments carries a pair of cup-shaped papillæ; the whole in a

rectangular brown area. Each spermatheca consists of a globular sac, with a narrow duct half its length, and a long straight diverticulum, longer than sac, with a terminal expansion sharply curved. The chætæ are about 50 in front of and 70 behind the clitellum. The dorsal pore is xi./xii. Paired cæca, simple, in xxvii. Spermiducal gland small, oval, deeply incised to form a number of radiating lobules; duct long, narrow, S-shaped, with sharp bends. No bulb.

Hab. Bonthain Peak, 6000 feet, Celebes.

EXPLANATION OF PLATES XX. & XXI.

PLATE XX.

Fig. 1. Perichæta jampeana.

1 *a.* View of male pores (σ), $\times 3$. (The lithographer has, in error, put 16 chætæ between the pores instead of 13.)

1 *b.* Spermiducal gland, $\times 8$. *gl*, the main part of the gland; *gl'*, a small piece underlying the penial duct and protruding beyond it.

1 *c.* Spermatheca.

Fig. 2. Perichæta digitata.

2 *a.* Spermiducal gland.

2 *b.* Spermatheca.

2 *c.* Cæcum (*c*), with neighbouring part of intestine. The septa (*s*) are inserted in the dilatations and not in the constrictions of the intestine.

Fig. 3. Perichæta bonthainensis.

3 *a.* View of the male pores (σ) and copulatory papillæ, $\times 4$. *po*, porophore.

3 *b.* Spermiducal gland, $\times 4$. *spd.*, sperm-duct.

3 *c.* Intestinal cæcum.

3 *d.* View of the posterior end of the worm from behind, to show the horizontal anus (*a*). *d.p.*, dorsal pores.

PLATE XXI.

Fig. 3 e. The septal pouches of some of the anterior segments. *p*, the bifid pouch in segment xvi.; *p'*, other pouches in succeeding segments; *o*, opening of pouches through the septa into the segments; *d.v.*, dorsal vessel; *int*, intestine; *s*, septa.

Fig. 4. Perichæta zebra.

4 *a.* Side view in middle region of the body, to show characteristic colour-bands, $\times 4$.

4 *b.* Ventral view, showing male pores (σ) and copulatory papillæ, $\times 5$.

4 *c.* A spermiducal gland, $\times 4$.

4 *d.* A spermatheca.

Fig. 5. Perichæta hexatheca.

5 *a.* Ventral view, to show the male pores (σ) and copulatory papillæ.

5 *b.* Spermiducal gland, $\times 3$.

Fig. 5 c. The hindmost spermatheca of the left side.

5 d. Dissection of the right side, the alimentary canal being turned aside, to show the six spermathecae in segments iv. to ix., $\times 3\frac{1}{2}$. *s*, septa; *n*, nerve-cord.

5 e. The intestinal caecum (*c*) of the left side, seen in side view. *d.v.*, dorsal blood-vessel; *n*, ventral nerve-cord.

Fig. 6. Perichaeta purpurea.

6 a. View of the spermathecal pores, with the anterior copulatory papillae (*pa*), in the glandular area (*gl*), $\times 8$.

6 b. View of male pores (σ) and posterior copulatory papillae, $\times 8$.

6 c. Spermiducal gland.

6 d. Spermatheca.

LXV.—*On Coleoptera from Aden and Somaliland.* By C. J. GAHAN, M.A., of the British Museum (Natural History).

THE following paper contains an account of two separate collections of Coleoptera—one made by Lieut.-Colonel Yerbury, R.A., at Aden and the surrounding district, the other by Mr. E. Lort Phillips in Somaliland. These collections have been presented to the Trustees of the British Museum, and comprise a number of interesting species, which, in addition to those described as new, had not previously been represented in the National Collection. In deference to the wishes of the donors, and in view of the faunistically interesting nature of the localities, I have endeavoured to make the lists of species as complete as possible. One genus and species of Buprestidæ from Aden and a few species of other families still remain undetermined; but even with those omitted the list of species from Aden &c. will show that Lieut.-Colonel Yerbury's collection is one of the largest yet made in that locality.

List of the Species collected by Lieut.-Colonel Yerbury at Aden and Lahej.

CICINDELIDÆ.

Cicindela alboguttata, Klug. Aden and Lahej.

— *aulica*, Dej. Aden.

— *melancholica*, Dej. Lahej.

— *rectangularis*, Klug. Aden and Lahej.

— *sp.*

— *immanis*, Bates. Lahej.

CARABIDÆ.

Anthia 12-guttata, Bon. Lahej.

Calleida sp. Aden.

Cymindis sp. Lahej.

GYRINIDÆ.

Dineutes æreus, Klug. Lahej.

HYDROPHILIDÆ.

Temnopterus spinipennis, Gory. Aden and Lahej.

HISTERIDÆ.

Hister memnonius, Erichs. Aden.

— *Gehini*, Marseul. Aden.

DERMESTIDÆ.

Attagenus posticalis, Fairm. Ann. Soc. Ent. Fr. (5) ix. p. 159. Lahej.

Anthrenus pulchellus, Gestro, Ann. Mus. Civ. Genov. xxvii. Lahej.

SCARABÆIDÆ.

Trox verrucosus, Reiche. Lahej.

Scarabæus cornifrons, Casteln. Lahej.

Gymnopleurus elegans, Klug. Aden and Lahej.

— *anthracinus*, Klug. Aden and Lahej.

Cheironitis osiridis, Reiche. Lahej.

Onitis alexis, Klug. Aden.

Onthophagus gazella, Fabr. ? Lahej.

Hybosorus Illigeri, Reiche. Lahej.

Stalagnosoma cynanchi, Gory & Perch. Aden and Lahej.

Anomala egregia, sp. n. Lahej.

Adoretus clypeatus, Burm. Aden and Lahej.

Leucocelis thoracica, Schaum. Lahej.

— *helenæ*, Schaum. Aden.

BUPRESTIDÆ.

Julodis spectabilis, Gory. Lahej.

— *Auscheri*, Blanch. Aden.

Psiloptera rugosa, Palis. de Beauvois. Aden.

— *arabica*, Gahan. Lahej.

— *galamensis*, Solier. Aden.

Sphenoptera cuneiformis, Gory. Lahej.

ELATERIDÆ.

Agrypnus notodonta, Latr. Aden and Lahej.

MELYRIDÆ.

Melyris bicolor, Fabr. Lahej.

CLERIDÆ.

Trichodes Martini, Fairm. Aden and Lahej.

Necrobia rufipes, De Geer. Lahej.

BOSTRICHIDÆ.

Phonapate nitidipennis, Waterh. Lahej.

TENEBRIONIDÆ.

- Zophosis acuticosta*, Fairm. Aden.
 — *quadricostata*, Sol. Lahej.
Arthrodeis bidentulus, Fairm. Aden.
Adesmia interrupta, Klug. Aden.
Mesostena puncticollis, Solier. Aden and Lahej.
Tentyria glabra, Solier. Aden.
Himatismus villosus, Haag-Rut. Aden and Lahej.
Ocnere hispida, Forsk. Aden.
Thriptera crinita, Klug. Aden and Lahej.
Micrantereus nitidus, sp. n. Aden.
Helopinus psalidiformis, Ancy. Aden.
Pimelia arabica, Klug. Lahej.
Vieta gibbicollis, Solier? Aden.
 — *gracilentia*, Ancy. Aden.
 — *clypeata*, sp. n. Aden.
Praogena gagatina, Mäkl. Aden.

ANTHICIDÆ.

- Formicomus cyanopterus*, Laferté. Lahej.
 — *latro*, Laferté. Lahej.

MORDELLIDÆ.

- Mordella bipunctata*, Germ. Aden and Lahej.

RHIPIPHORIDÆ.

- Emenadia flabellata*, Fabr. Lahej.
 — *bipunctata*, Fabr. Lahej.
 — *nigripennis*, Gerst. Lahej.
 — *scutellaris*, Gerst. Lahej.
Rhipiphorus caffer, Gerst.? Aden and Lahej.

CANTHARIDÆ.

- Mylabris arabica*, Pall. Aden and Lahej.
 — *nigriplantis*, Klug. Lahej.
 — *gilvipes*, Chevr. Lahej.
 — *maculiventris*, Klug. Aden and Lahej.
Coryna rubricollis, Marseul. Aden and Lahej.
Ceroctis Yerburyi, sp. n. Aden.
Epicaula suavis, Haag-Rut. Aden and Lahej.
Lytta suturella, Haag-Rut. Lahej.
Leptopalpus quadrimaculatus, sp. n. Lahej.

CEDEMERIDÆ.

- Ananca spurcaticollis*, Fairm. Aden and Lahej.
 — *Martini*, Fairm. (*Chitona*). Aden.

CURCULIONIDÆ.

- Cleonus cinctiventris*, Fähr. Lahej.
 — *tomentosus*, Fähr.? Aden.
Ocladius setipes, Ancy. Aden.

CERAMBYCIDÆ.

- Titheos arabicus*, Thoms. Lahej.
Diorthus simplex, White (*Pachydissus*). Aden.
Coptops ædificator, Fabr. Aden.
Crossotus arabicus, sp. n. Lahej.

BRUCHIDÆ and CHRYSOMELIDÆ.

- Caryoborus pallidus*, Oliv. Aden.
 — *gonagra*, Fabr. Lahej.
Camptolenes cingulata, Lefèv. Aden and Lahej.
Titubæu arabica, Oliv. Aden and Lahej.
 — sp. Lahej.
Clytra crocata, Lac. Lahej.
Euryope quadrimaculata, Oliv. Aden.
Pseudocolaspis Lefevrei, Baly. Aden and Lahej.
Lahejia cinerascens, gen. et sp. n. Lahej.
Aulacophora delata, Erichs. Lahej.
 — *foveicollis*, Kust. Lahej.
Diacantha (?) *dubia*, sp. n. Lahej.
Hyperacantha sp. Lahej.
Diorhabda octocostata, sp. n. Aden and Lahej.

COCCINELLIDÆ.

- Chilocorus distigma*, Klug. Lahej.
Epilachna chrysomelina, Fabr. Lahej.
Chilomenes vicina, Muls. Lahej.
Bulæa pallida, Muls. Lahej.
Hippodamia variegata, var. *dissimilis*, Muls. Lahej.

*List of the Species collected by Mr. E. Lort Phillips in
 Somaliland.*

- | | |
|---|--|
| <i>Anthia ferox</i> , Thoms. | <i>Agrypnus luridus</i> , Fabr. |
| <i>Polyhirna tetrastigma</i> , Chaud. | <i>Melyris rubrocincta</i> , Fairm. |
| <i>Tefflus Chandroiri</i> . | <i>Apate terebrans</i> , Pall. |
| <i>Dineutes grandis</i> , Klug. | <i>Phonapate nitidipennis</i> , Waterh. |
| <i>Temnopterus spinipennis</i> , Gory. | <i>Adesmia Phillipsi</i> , sp. n. |
| <i>Trox denticulatus</i> , Oliv. | — <i>consimilis</i> , sp. n. |
| <i>Hybosorus Illigeri</i> , Reiche. | <i>Pimelia cenchronota</i> , Fairm. |
| <i>Scarabæus isidis</i> , Casteln. | <i>Thriptera crinita</i> , Klug. |
| <i>Gymnopleurus virens</i> , Erichs. | <i>Sepidium crassicaudatum</i> , Gestro. |
| <i>Copris confusa</i> , Boh. ? | <i>Mylabris rutilicollis</i> , Fairm. |
| <i>Anomala egregia</i> , sp. n. | <i>Anoplostetha lactator</i> , Fabr. |
| — sp. | <i>Ceroplesis Revoili</i> , Fairm. |
| <i>Vertumnus cuniculus</i> , Burm. | <i>Titoceres jaspideus</i> , Serv. |
| <i>Chrysobothris abyssinicus</i> , Fairm. | <i>Crossotus Phillipsi</i> , sp. n. |

*Descriptions of new Species and References to some previously
 described Forms.*

Anomala egregia, sp. n.

Flavo-testacea; clypeo, tibiis posticis et tarsis omnibus rufo-piceis;
 tibiis anticis extus dentibus duobus nigris armatis.

♂. Abdomine longitudinaliter paullo concavo, clavis antennarum elongatis, unguiculis tarsorum omnium simplicibus.

♀. Abdomine convexo, clavis antennarum minus elongatis, unguiculo antico tarsorum anteriorum mediorumque bifido.
Long. 15-18, lat. ad hum. 7-9 mm.

Hab. Somaliland (*Lort Phillips*) and Aden (*Yerbury*).

Head closely punctured, with the clypeus of a reddish-brown colour and its raised anterior margin blackish. Prothorax subnitid, very minutely and rather sparsely punctured, with the anterior margin in the middle and a small spot on each side of the disk of a reddish-brown colour; lateral margins nearly parallel from the base to the middle, and thence converging up to the anterior angles, which are slightly produced. Elytra each with four impunctate, narrow, subcostate intervals, the rest of the surface rather closely punctured. Posterior tibiæ and all the tarsi of a reddish-brown colour.

Though this species differs little in colour and general appearance from many previously described, it offers a special point of interest in the fact that the claws of the tarsi exhibit a difference of structure according to the sex, the large anterior claw of all the tarsi in the male being simple, while the anterior claw of the anterior and middle tarsi of the female is slit at the apex. A difference in the structure of the claws has hitherto been regarded as a basis for arranging the species of this large genus in groups or subgenera—so that, with a view to finding out whether the difference might not in other cases also prove to be sexual, I have examined a number of different species, but with the result, so far, that I have failed to discover a second example.

Trichodes Martini, Fairm.

Trichodes Martini, Fairm. Bull. Soc. Ent. France, 1896, p. 223.

Cyaneus, supra crebre fortiterque punctatus; elytris rufis, fasciis duabus transversis—una ante, altera pone medium—et apice extrema cyaneis ornatis; antennis, palpis et tarsis anticis fulvotestaceis.

Long. 9-17, lat. $2\frac{3}{4}$ - $5\frac{1}{2}$ mm.

Hab. Lahej and Aden (*Yerbury*).

Dark blue in colour, with the exception of the elytra, antennæ, palpi, and anterior tarsi. The elytra are reddish, with the extreme apex and two nearly straight transverse bands—one just in front of the middle, the other, broader, lying a little way behind the middle—dark blue. Upperside

very closely and rather strongly punctured, and somewhat opaque in appearance. Underside more glossy; legs and breast closely and somewhat rugosely punctured, and more thickly covered with yellowish hairs; abdomen sparsely punctured. Antennae, palpi, and front tarsi testaceous in colour.

(This description was already written before M. Fairmaire's paper had come under my notice.)

Phonapate nitidipennis, Waterh.

Apate nitidipennis, Waterh. Proc. Zool. Soc. 1881, p. 472.

To this species I refer four male examples obtained by Mr. Lort Phillips in Somaliland. These examples agree very well with the type specimen (also a male) from Socotra. A male specimen obtained by Col. Yerbury at Aden is more strongly punctured than the type and has the raised lines of the elytra less distinct, so that it possibly belongs to a different species.

A very closely allied species is represented in the Museum collection by male and female examples from Fao on the Persian Gulf, Muscat in Arabia, and two males from Bagdad. The females of this species show very clearly the stridulating surface on the anterior femora, and the ribs (against which the surface scrapes) on the sides of the prothorax. This stridulating-apparatus, which is not only novel as regards its position, but remarkable also in being peculiar to the female sex, was first noticed by M. Lesne, who described it in characterizing the genus *Phonapate* (Ann. Soc. Ent. France, 1895, p. 178).

An undescribed species of this genus occurs in the North Hills, Burma, whence a female specimen has been sent by Mr. Watson. It is evident, therefore, that the genus has a pretty wide range.

Adesmia Phillipsi, sp. n.

Nigra, sat nitida; capite parce punctato, labro antice paullo emarginato; pronoto parce punctato et prope latera transversim rugosulo, medio breviter lineato-sulcato et utrinque obliquiter vage impresso; elytris subovatis, supra convexis cancellato-costatis, postice valde declivis et subacuminatis, utroque elytro costis quatuor longitudinalibus quarum externa obtusa sat dense sed haud regulariter granulata; prosterno postice valde declivo, non producto; mesosterno antice haud gibboso.

Long. 15-19, lat. ad med. elytrorum 9-11 mm.

Hab. Somaliland (*E. Lort Phillips*).

Black and somewhat shiny. Head distinctly but not thickly punctured. Prothorax transverse, slightly produced in front at the antero-lateral angles, rather sparingly punctured above, transversely wrinkled towards the sides, with a short linear groove along the middle of the disk and an obliquely transverse impression on each side. Elytra oval, convex above, strongly declivous behind; each with four longitudinal costæ, the intervals between which are divided up into a number of small rectangular areas by means of short, transverse, raised lines: the fourth or external costa is obtuse and covered with a number of small granules; the deflexed side below it is somewhat uneven and bears a number of ill-defined granules; the interval between the third costa and the fourth is broader and more concave than the others, and the transverse lines dividing it are less well defined. The prosternal process is strongly declivous, almost vertical behind, but is not produced, and the mesosternal process slopes gradually in front and presents no tubercle or swelling.

Adesmia consimilis, sp. n.

Ovata, nigra, nitida; capite irregulariter fortiterque punctato; pronoto dense rude punctato, lateribus antice productis; elytris supra convexis, cancellato-sculpturatis, postice valde declivis, utrisque costis quatuor longitudinalibus quarum duabus exterioribus ad basin conjunctis, latere deflexo subrugoso; prosterno postice paullo producto; mesosterno antice in medio obtuse tuberculato.

Long. 12-15, lat. 7-10 mm.

Hab. Somaliland (*E. Lort Phillips*).

This species is somewhat like the preceding one in the sculpturing of the elytra, but the transverse lines between the longitudinal costæ are less regular and distinct, and the third and fourth costæ on each side unite together at the base. It differs more particularly, however, in its shorter form and in the close coarse punctuation of the head and pronotum; the prosternal process, also, is more horizontal below and is slightly produced behind, to rest against an obtuse tubercle which lies on the anterior face of the mesosternum.

Vieta clypeata, sp. n.

Squamis pallide griseis fere omnino tecta; clypeo antice triangulariter producto et paullo curvato; prothorace utrinque tuberculo bifurcato armato, supra medio paullo elevato et antice tuberculo duobus approximatis instructo; elytris sat valde denseque punc-

tatis, utrisque seriebus duabus tuberculorum acutorum instructis. Long. 12, lat. ad med. elytrorum 4 mm.

Hab. Aden (*Yerbury*).

Almost entirely covered with greyish-white scales. Clypeus prolonged below in a slightly curved and pointed process, the edges of which are raised, so that its surface is concave in front. Prothorax furnished on each side with a prominent tubercle giving off two spiniform processes, the posterior of which is curved backwards; disk of the thorax slightly raised in the middle, and furnished at the middle of its anterior margin with two rather small, closely approximated, and almost vertically raised tubercles. Elytra elongate-ovate in outline, rather strongly and closely punctured; each furnished with two rows of sharp spiniform tubercles—one row marking the boundary between the deflexed side and the slightly convex disk, the other midway between this and the suture.

Micrantereus nitidus, sp. n.

Anguste ovalis, niger, nitidus; capite crebre punctato, antice arcuatum impresso et ad marginem inferiorem leviter sinuato; prothorace nitido, crebre subtiliterque punctato, lateribus parum rotundatis; elytris nitidis grosse sat sparseque punctatis, utrisque costis tribus angustis instructis; corpore subtus pedibusque dense subrugoseque punctatis.

♂. Prothorace minus transverso et ad latera minus rotundato; tibiis anticis incrassatis et subtus canaliculo villosio instructis; femoribus intermediis postice versus apicem dente sat magno armatis, tibiis intermediis leviter curvatis, prope basin abrupte angustatis, subtus medio parum canaliculatis, et ad apicem dente armatis.

Long. 11–12, lat. ad med. elytrorum 5 mm.

Hab. Aden and Lahej (*Yerbury*).

This species seems to be most nearly allied to *M. tentyrioides*, Pasc., which it resembles much in shape. It is quite glossy on the thorax and elytra; the latter are strongly but not thickly punctured, and each bears three narrow longitudinal costæ, of which the outer one is less distinct than the other two. The anterior tibiæ of the male are thickened, and in their distal three fourths bear a groove underneath, which is lined with a longish grey-tawny pubescence; the tarsi are not dilated and are clothed underneath with rather long tawny hairs instead of the pad of short hairs met with in many species of the genus.

Praogena gagatina, Mäkl.

The examples obtained by Col. Yerbury at Aden are of a more intense black colour than those which I have seen from Senegal, but exhibit no structural differences by which they could be regarded as specifically distinct.

While examining this and various other species of the genus *Praogena*, I have had occasion to observe that the hinder part of the gular surface of the head is furnished with a stridulating area, and I have little doubt that sounds are produced by the friction of this area against the anterior edge of the prosternum when the head is moved backwards and forwards towards the prothorax. As the presence of a stridulating area in this position does not seem to have been previously noticed, I think it worth calling attention to, especially as the character may prove helpful in distinguishing some of the genera of Tenebrionidæ.

Rhipiphorus caffer, Gerst.?

The specimens taken by Colonel Yerbury at Aden and Lahej may possibly belong to a distinct species, as I have had no Caffrarian or other examples of *R. caffer*, Gerst., for comparison. They differ from *R. subdipterus*, Bosc, by their smaller size and in being more strongly and closely punctured, two characters mentioned by Gerstaecker as distinguishing *caffer*, Gerst., from *subdipterus*, Bosc; in the females the legs are pitchy black and the abdomen yellowish testaceous, with fuscous patches on the sides; in the males the legs and abdomen vary in colour, one example having all the legs and the greater part of the ventral side of the abdomen yellowish testaceous, while in a second example the anterior legs and the base of the abdomen only are testaceous; the elytra are in some specimens marked with a fuscous patch at the shoulders, in others they are entirely pale.

Long. 4-6½ mm.

Ceroctis Yerburyi, sp. n.

Niger; supra dense fortiterque punctatus, vix nitidus; elytris rufis, fasciis tribus nigris—una inter medium basinque, secunda mediana, tertia inter medium apicemque; antennis rufis, articulis duobus basalibus nigris; corpore subtus nigro, sparsim cinereo-pubescente.

Long. 11-13, lat. 3½-4 mm.

Hab. Aden (*Yerbury*).

Black, thinly clothed with greyish pubescence, which is somewhat longer and more conspicuous on the underside. Head, prothorax, and elytra very closely punctured. Elytra of a reddish colour; each marked by three transverse black bands, of which the first, between the base and the middle, does not quite reach to the suture or the outer margin, while the other two bands, one at the middle and one between the middle and apex, are both complete. First two joints of the antennæ black, the remaining joints of a bright reddish colour; the processes of the joints from the fifth to the tenth are fairly long, that of the fourth is short, while the process of the third is hardly conspicuous.

Leptopalpus quadrimaculatus, sp. n.

L. rostrato similis, sed minor, elytris sine maculis basalibus, et corpore subtus toto fulvo.

Long. 8, lat. 3 mm.

Hab. Lahej (*Yerbury*).

The genus *Leptopalpus* (easily recognized by the remarkable elongation of the maxillary palpi, which, when closely apposed, have some resemblance to the beak of a bug) has been hitherto represented by only one known species—*L. rostratus*, Fabr. From this species the present one may be distinguished by its smaller size, the wholly fulvous colour of its underside, and the absence of black spots from the base of the elytra. Each elytron has but two round black spots, one near the middle of its length, the other between this and the apex.

Ananca Martini, Fairm.

Chitona Martini, Fairm. Bull. Soc. Ent. Fr. 1896, p. 224.

Capite supra nigrescente, pube brunneo-grisea obtecto; prothoracis disco nigro, nitido, sat dense punctulato et quadri-impresso, lateribus et linea media longitudinali griseo-pubescentibus; elytris brunneo-griseo-pubescentibus, sutura angustim et linea dorsali utrinque cinereis; corpore subtus cinerascente.

(♂) Articulo primo tarsorum intermediarum quam secundo brevior et ad basin subuncinato-emarginato.

Long. 6–10 mm.

Hab. Aden (*Yerbury*).

This species resembles some of the darker forms of *Ananca spurcaticollis*, Fairm., but may be distinguished by the following characters:—Clypeus shorter; prothorax less expanded anteriorly, black above except at the sides and

extreme anterior and posterior margins, the disk rather thickly punctured, carrying four well-marked impressions, and having a line of ashy-grey hairs along the middle; each elytron with a line of ashy-grey hairs along the middle and a similar line at the sutural margin; first joint of the middle tarsus of the male much shorter than the second and having a slight projection underneath, which is somewhat emarginate at the anterior end, forming a kind of hook. In the female the corresponding joint is normal and longer than the second joint. (In the male of *A. spurcaticollis* the first joint of the middle tarsus is simple, but the tibiæ of the same legs are bent near the extremity.)

The above description was written before I had an opportunity of seeing M. Fairmaire's paper and may be allowed to stand, as it supplements his description, in which no mention is made of the sexual differences. The species does not possess the chief distinguishing characters of the genus *Chitona*, since the head is not prolonged in a distinct muzzle, while the eyes are slightly emarginate in front, with the antennæ in close proximity to them.

Crossotus arabicus, sp. n.

Pube griseo-cinerea obtectus; prothoracis disco, femoribus, pectore et abdomine parce nigro-punctatis; elytris utrisque prope medium fasciulo pilorum nigrorum ornatis; antennis (♀) quam corpore paullo longioribus, cinereo-pubescentibus, subtus parce nigro-setosis.

Long. $15\frac{1}{2}$, lat. 6 mm.

Hab. Lahej (*Yerbury*).

Covered with pale grey pubescence, which on the base of the elytra is mixed with pubescence of a brownish tint. Disk of prothorax marked with some scattered shining black punctures, and bearing two slightly raised transverse elevations on each side. Each elytron bearing a small tuft of black hairs at about the middle of its length. Femora, breast, and abdomen marked with scattered shining punctures like those on the disk of the prothorax. Prosternum subvertical in front and parabolically bowed behind. Antennæ of the female a little longer than the body, covered with grey pubescence, and having a short and sparse fringe of black setæ underneath.

Crossotus Phillipsi, sp. n.

Griseo-pubescent; capitis fronte, pronoto, sternis pedibusque et plaga laterali utrinque elytrorum pallidioribus; prothorace

lateraliter pone medium valde tuberculato, supra tuberculis quatuor transversis instructo; elytris punctatis, utrisque prope basin fasciulo distincto pilorum fuscorum ornatis; antennis quam corpore paullo longioribus, griseis, subtus breviter setosis, articulis 3^o-10^{um} basi pallidioribus, articulo 1^o nigro-punctato.

Long. 20, lat. 9 mm.

Hab. Somaliland (*E. Lort Phillips*).

Covered with pubescence, consisting chiefly of short pale grey or nearly white hairs mixed more or less with tawny and dark brown hairs. On the front of the head, pronotum, sterna, and a patch on each side of the elytra the pubescence is mostly whitish and only slightly mixed with tawny hairs. Prothorax furnished on each side with a large tubercle behind the middle, and a small obtuse tubercle in front of the middle, disk with four cariniform transverse tubercles. Elytra each with a distinct tuft of dark brown hairs at a short distance behind the base.

LAHEJIA, gen. nov. (*Eumolpinorum*).

Clothed with pubescence. Eyes somewhat prominent, with a very feeble sinuate emargination in front. Inner margins of antennary condyles slightly raised, so that the front of the head appears bounded by a short ridge on each side. Epistome scarcely visible. Prothorax without sharp lateral margins, slightly rounded at the sides and somewhat narrowed towards the base; its greatest width about equal to its median length; anterior border of prosternum concave; intercoxal laminae of pro- and mesosterna rather narrow. Femora thickened below the middle of their length; tibiae entire; tarsi rather slender, with first joint of each about as long as the two following joints together; claws bifid. Antennae about half as long as body; first joint short, oval, second nodular, third slender, nearly three times as long as second; seventh to tenth joints somewhat flattened and sub-triangular in shape.

Lahejia cinerascens, sp. n.

Piceo-nigra, subnitida, griseo sparse pubescens; capite antice et subtus testaceo; pedibus annisque flavescentibus, his articulis quinque apicalibus infuscatis.

Long. 3-3½, lat. 1½ mm.

Hab. Lahej (*Yerbury*).

Pitchy black, veiled by a sparse grey pubescence. Head

closely punctured, black above, with the clypeus, labrum, and underside testaceous. Prothorax very minutely and closely punctured. Elytra closely and more strongly punctured, and having the glossy derm only partially concealed by the short grey pubescence. Legs and first five or six joints of the antennæ yellowish testaceous, the remaining joints more or less infusate.

The affinities of this new genus seem to be greatest with *Psathyrocerus*, Blanch., which consists entirely of South-American species. *Psathyrocerus* has hitherto been placed in the subfamily Criocerinae, though it differs but little in structural characters from *Habrophora*, Erichs., a genus of Eumolpinae placed in the group Leprotites.

Diacantha (?) *dubia*, sp. n.

♂. Testacea, elytris pectoreque nigris; pronoto antice ad latera parce punctato, disco leviter transversim impresso, medio basis retrorsum acute sed paullatim producto; elytris parce minuteque punctatis, utrisque ad basin prope suturam foveola impressis; unguiculis tarsorum appendiculatis.

Long. 5 mm.

Hab. Lahej (*Yerbury*).

Reddish testaceous, with the exception of the elytra and hind breast, which are black. Prothorax shining, minutely and sparsely punctured towards the sides in front, impunctate on the middle of the disk, which bears a feeble transverse impression; produced at the middle of the base into a small pointed process, which covers over the scutellum. Elytra black and glossy, feebly and sparsely punctured, and each furnished with a small rounded pit placed close to the scutellum.

The backward process of the pronotum and the basal pits of the elytra are evidently characters peculiar to the male sex and similar to those met with in many species of *Diacantha*. The claws of the tarsi are appendiculate, and the species has therefore some relation to the genus *Hyperacantha*.

Diorhabda octocostata, sp. n.

Sordide flava; capite pronotoque sat valde punctatis; elytris utrisque quadricostatis, costa tertia ab sutura brevi, costa laterali acuta; elytris inter costas minute crebreque punctatis et subinfuscatis; antennis fuscis, articulis tribus vel quatuor basalibus flavescens; tarsis infuscatis.

Long. 5-7 mm.

Hab. Aden and Lahej (Yerbury); Syria and Mesopotamia (*Baly Collection*).

Dirty yellow in colour, with a spot on the vertex of the head, the intervals between the costæ of the elytra, the antennæ and tarsi more or less brownish; first three or four joints of the antennæ partly yellowish. Upper part of the head and the disk of the prothorax rather strongly punctured, the latter sinuate in the middle both at base and apex. Elytra each with four raised lines or costæ, of which the third is short, extending from the middle of the elytron to about the hinder fourth or fifth part; the outer costa begins just behind the shoulder, and is sharp and distinct up to a short distance from the apex; the concave intervals between the costæ are closely and finely punctured. The last ventral segment of the male is somewhat sinuately emarginate at the apex, with a triangular depression just in front of the emargination.

LXVI.—*Descriptions of Four additional* new Mammals from Madagascar.* By Dr. C. I. FORSYTH MAJOR.

1. *Microgale taiva* †, sp. n.

Represented by a single specimen, a female not fully grown, for, although all the true molars are completely developed and in use, most of the milk-teeth are still *in situ*. The dimensions of the adult animal would be about intermediate between *M. longicaudata* and *M. Cowani* on the one side, and *M. Thomasi* on the other. The present specimen is only slightly larger than full-grown individuals of the former two and of *M. crassipes*, the type of which I have examined in Paris.

Besides the general dimensions, this new species is particularly distinguished by its long tail, which, though shorter than in *M. longicaudata*, is much longer than in all the other known species of *Microgale*. The coloration of the fur, whilst agreeing with that of *M. Cowani* and *M. Thomasi*, is somewhat darker than in *M. longicaudata*.

In the general form of the skull this new form agrees, too, with the above-named species, and more than all with *M. Cowani*, whereas *M. longicaudata* has a somewhat

* See *suprà*, p. 318.

† The section of the Betsimisaraka tribe inhabiting the forest east of Betsileo are called Tanala by their neighbours. The name they give to themselves in the northern portion of this forest, in which Ambohimombo is situated, is Taiva.

higher and stouter facial region. At any rate, in all of them the contours of the skull are cylindrical, and not pyriform as in *M. longirostris*.

Measurements of type and unique specimen, ♀ (M. 154), in millimetres:—

Head and body 83; tail 87; ear 12·5; hind foot 18·3.

Basal length of skull 21; absolute length 23.

Hab. Ambohimitoimbo forest, Tanala Country, 19th Jan., 1895.

2. *Microgale pusilla*, sp. n.

The smallest of the Centetidæ hitherto known. Coloration of the fur like in *M. longicaudata*, viz. lighter than in *M. Cowani* and *M. Thomasi*, being light brown above, with a much paler tinge below. Skull and dentition, apart from size, not differing in any essential characters from the above-mentioned species; in the conformation of the anterior upper incisor this new species agrees with *M. longicaudata* in having its secondary cusp minute, whilst it is much larger in *M. Cowani*.

Dimensions in millimetres of type (M. 1359), ♂:—

Head and body 53; tail 74; ear 11; fore foot 11; hind foot 13.

Basal length of skull 15.

Hab. Forest of the Independent Tanala of Ikongo, in the neighbourhood of Vinanitelo, 27th May, 1896. Fossil in the Children's Cave, near Sirabè (Vakinankaratra).

3. *Eliurus minor*, sp. n.

The smallest of the known species of this genus. General colour brownish grey; underparts fawnish. Proximal two fifths of the tail scaly and almost naked, the brownish hairs increasing in number and length towards the tip, with tendency towards a distichous arrangement; but the tail is far from being so bushy as in *E. myoxinus*, Milne-Edw., the type of which, by Prof. Milne-Edwards's kindness, I have been able to examine in Paris.

Measurements of type, skin (M. 494), ♂:—

Head and body circa 114 millim.; tail circa 98.

Basal length of skull 24·5; absolute length 29; length of upper molars 4.

Hab. Ampitamè forest (N.E. Betsileo), 6th July, 1895.

4. *Eliurus tanala*, sp. n.

More closely related to *E. Majori*, Thos.*, than to the other two species, but distinguished from the first by a somewhat larger size, by a slight difference in coloration—the

* Ann. & Mag. Nat. Hist. ser. 6, vol. xvi. (1895) p. 164.

centre of the back being of a darker grey and the under surface yellowish white—as well as by a longer snout and smaller molars.

Measurements in millimetres of *E. tanala* and *E. Majori*:—

	<i>E. tanala</i> ♂ (M. 1358), type.	<i>E. Majori</i> ♂ (M. 166), type, measured in the flesh.	<i>E. Majori</i> ♂ (M. 430).	<i>E. Majori</i> ♂ (M. 536).
Length of head and body..	151	141	143	145
„ tail	189	154	154	164
„ hind foot	31	27	25	26
„ ear	24	19	21·5	25·5

Measurements of skulls:—

	<i>E. tanala.</i>			<i>E. Majori.</i>	
	M. 1358 (♂), type.	(M. 1515), ♀.	M. 1510 (♂).	M. 166, type (♂).	(M. 159), ♂.
Basal length.....	35	34·2	35	30·6	31
Absolute length ..	41·6	41	40	36·2	—
Length of nasals ..	16	17	16·7	14·2	14
„ frontals .	13	13	12	12	12
„ parietals.	7·3	7	6·5	6·5	6·5
Length of upper molar series ..	6	5	5·5	6·6	6·3
Length of lower molar series ..	5·5	5·5	5·5	7	6·3

Hab. Forest of the Independent Tanala of Ikongo, in the neighbourhood of Vinanitelo, thirty miles south of Fianarantsoa.

LXVII.—*Description of a new Species of Stick-Insect* (Phasmidæ) *from British Central Africa.* By W. F. KIRBY, F.L.S., F.E.S., &c.

MRS. MOIR, a lady whose husband is engaged on a coffee-plantation at Lauderdale, British East Africa, has lately returned to Scotland for the winter, and has brought with her an unusually fine Phasmide, which has been secured for the Natural History Museum at South Kensington. It appears to be quite new, and I therefore describe it as

Palophus Moiræ.

Female.—Deep chestnut-brown, inclining sometimes to reddish and sometimes to black; pubescent; head with a high double reddish crest, contiguous in front and sinuated behind; head above with two rather irregular rows of short spines on each side of the median line, and some scattered

spines on the sides; prothorax and mesothorax with numerous large and small red spines, irregularly arranged; abdomen with the fifth segment carinated and concave at the extremity above, and with a short carina on each side coalescing with the terminal one, each preceded by a round black spot; front coxæ with two or three small spines; femora lobate at the extremity, front femora straight, left front tibia with a lobe on the upper carina at two thirds of its length; first joint of left tarsi also lamellate above; middle and hind femora much curved, the middle tibiæ lamellate above and below near the base; tegulæ brown, a large hump, longer than broad and rounded at the summit, near the base. Wings with the costal area reddish brown, black at the base; a grey spot on the costa before the middle; the membranous part of the wings black, with numerous irregular waved and broken bands and spots of dull testaceous yellow, which do not anastomose, paler towards the inner curve of the margin, which becomes smoky brown with subhyaline markings.

	millim.
Long. corporis	223
„ capitis	9
„ pronoti	12
„ mesonoti	35
„ metanoti	31
„ segmenti mediani	19
„ tegminum	30
Exp. al.	232
Long. fem. ant.	73
„ „ med.	50
„ „ post.	64

This splendid species is the largest winged African Phasmide yet discovered, being nearly 9 inches long and more than 9 inches in expanse of wing. It greatly resembles the well-known *Palophus centaurus*, Westwood, which also exhibits a similar structure at the extremity of the fifth segment of the abdomen; but the shape of the crest, the spiny head and thorax, and the much longer wings are amply sufficient to distinguish it.

Mrs. Moir has communicated the following account of the capture in a letter to Miss E. M. Sharpe:—"I found it myself one morning hanging on to the clothes-ropes, when going to hang out something to dry, and only on its refusing to be shaken off did I find out it was alive. Mr. Moir injected carbolic, with a view to preserving it better, and only then did it put out its wings."

The stick-like appearance and sluggish habits of these insects are quite sufficient to account for their being rarely noticed, in spite of their large size and conspicuous appearance when the wings are expanded.

LXVIII.—*Pseudodiadema Jessoni*, *sp. n.*, an *Echinoid* from the *English Oxford Clay*. By J. W. GREGORY, D.Sc., F.G.S.

Pseudodiadema Jessoni, *sp. n.*

Diagnosis.—*Test* small, high, tumid. Aboral half slightly more conical than the lower.

Apical system fairly large, less than half the diameter of the test, pentagonal.

Ambulacra narrow. (The plates are normal, *i. e.* simple primary plates near apical system and compound plates of three primaries at ambitus.) Two rows of small tubercles down each ambulacrum.

Interambulacra.—Seven or eight plates in each series in the adult. The plates are high; each of the five middle plates has a single large tubercle upon it, occupying nearly the whole of the plate. The uppermost plate has no tubercle; the uppermost tuberculate plate has a complete scrobicular circle; in the remainder the scrobicular areas are confluent. The granulation occurs mainly as a narrow band along the middle of the interambulacrum, but it is very limited in amount.

Peristome large, circular; deep branchial clefts.

Dimensions of E 3937:—

	millim.
Diameter	14
Height	8
Diameter of apical area	6
„ peristome	8
Width of ambulacrum at ambitus	2.25
„ interambulacrum at ambitus	6.25
Number of pore-pairs in one series	25–26
Number of interambulacral plates in one series ..	7 or 8

Distribution.—Oxford Clay, St. Ives, Hunts. Collected by T. Jesson, Esq.

B.M. type E 3936; larger specimen E 3937.

This small Echinid is of interest as the only species as yet recorded from the Oxford Clay of this country. The British Museum collection contains twenty specimens which were found by Mr. Jesson, and there are others in the Woodwardian Museum at Cambridge. The species is characterized especially by its high unituberculate plates, thick form, confluent scrobicular areas, and the sparseness of the granules.

The large size of the apical area suggests at first that the

Echinid may be an *Acrosalenia*; but the structure of the ambulacral plates near the peristome shows that it belongs to a different family. In spite of the absence of the apical system there is no doubt that it is a *Pseudodiadema*.

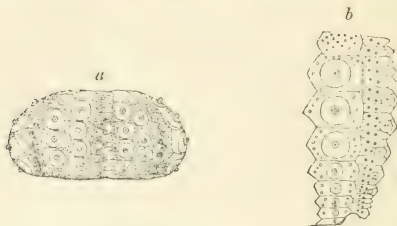


Fig. *a*.—Test of E 3936, $\times \frac{30}{11}$ diam.

Fig. *b*.—An ambulacrum and interambulacrum, $\times 5\frac{1}{2}$ diam.

Its closest ally is *Pseudodiadema Beaudouini*, Cott.*, from the Upper Oxfordian of Châtillon-sur-Seine, Côte d'Or, which is said to be very rare. From this the English species differs by being much higher in proportion to its width; the ratios in the new species are 1:3, and in *P. Beaudouini* 1:2; the number of interambulacral plates is smaller, the granules are less abundant, there is no tubercle on the uppermost interambulacral plate, and the pore-pairs near the peristome are in a straight single series.

The character of the granulation, the number of interambulacral plates, and the size of the interambulacral plates are points which the new species has in common with *Pseudodiadema Langi*, Desor†; but from this it differs by the large size of the ambulacral tubercles and the crowding of the pore-pairs near the peristome in the continental species. The same characters separate it from *Pseudodiadema priscum* (Ag.)‡ and *Pseudodiadema drogiacum* § (Cott.), with both of which it has resemblances in some details.

* G. Cotteau, Pal. franç., Terr. jurass. t. x. pt. ii.; Échinides réguliers, livr. 7, 1882, p. 287, pl. cccxxxviii. figs. 1-5.

† See especially figures by Desor and de Loriol, Échinol. helvét. pl. xxiv. fig. 2.

‡ L. Agassiz, Cat. Syst. Ectyp. foss. Ech. Mus. Neocom. 1840, p. 8. Figured *e. g.* by Desor and de Loriol, *op. cit.* pl. xxiv. fig. 3; Cotteau, *op. cit.* pl. cccxxxv.

§ Cotteau, Et. Éch. Yonne, p. 156, pl. xix. figs. 6-10, and *op. cit.* pl. cccxliii. figs. 7-13.

LXIX.—*A new Butterfly of the Genus Acræa from Tugela, S. Africa.* By A. G. BUTLER, Ph.D. &c.

MR. G. H. BURN, of Tugela, Natal, South Africa, writes under date of September 16th as follows:—"I am to-day forwarding for your inspection two specimens of an *Acræa* which I have taken here, and which I believe is new to science. This butterfly I first took on September 5th, 1894, and I sent two or three specimens to Mr. R. Trimen, then Curator of the Cape Museum. In his letter acknowledging receipt Mr. Trimen says that the *Acræa* is new to science, and asks me to try and obtain the paired sexes, as the females (or those specimens which had the appearance of females) did not exhibit the ordinary distinguishing characters of females of the genus *Acræa*. I send you what I believe to be a male and a female. Since 1894 I only got twelve or thirteen specimens until this month."

The examples forwarded are undoubtedly a pair. In colouring they do not differ, excepting that the male is slightly brighter in tint; but the male is considerably smaller than the female, the discrepancy in size being greater than in the allied species. It may, however, vary in this respect.

Acræa Burni, sp. n.

Intermediate between *A. machequena* and *A. obeira*, the pattern being identical with that of the latter species, but the basal half of the primaries and entire ground-colour of the secondaries is ochreous buff; the spots on the secondaries are smaller than in *A. obeira*, and the orange spots upon the dusky outer border are less deep in colour.

Expanse of wings, ♂ 38, ♀ 60 millim.

Tugela, Natal, South Africa (*G. H. Burn*).

From *A. machequena* this species is easily distinguished by the arrangement of the spots on the secondaries, which, in that butterfly, has the character of that of *A. ranavalona*.

LXX.—*Descriptions of Two new Frogs from Lake Tanganyika, presented to the British Museum by Mr. W. H. Nutt.*
By G. A. BOULENGER, F.R.S.*Rana Nutti*.

Vomerine teeth in two strong oblique series between the choanæ. Head as long as broad or slightly broader than

long; snout rounded, scarcely projecting, slightly longer than the diameter of the orbit; canthus rostralis obtuse; loreal region very oblique and slightly concave; nostril equally distant from the eye and the tip of the snout; interorbital space a little narrower than the upper eyelid; tympanum very distinct, three fourths the diameter of the eye. Fingers pointed, first longer than second; toes slender, pointed, three-fourths webbed; subarticular tubercles small; a small elliptical inner metatarsal tubercle measuring one third the length of the inner toe. Tibia as long as the fore limb; tibio-tarsal articulation reaching the tip of the snout or a little beyond. Skin smooth; a narrow glandular dorso-lateral fold. Olive above; sides of body and limbs vermiculate or marbled with blackish; a dark temporal spot; a light streak from below the eye to the angle of the mouth; limbs with dark cross-bands; lower parts white, throat spotted or marbled with brown. Male with internal vocal sacs.

From snout to vent 80 millim.

Two specimens.

Rana pulchra.

Vomerine teeth in two small, oblique, oval groups between the choanæ. Head large, broader than long; snout obtusely pointed, slightly projecting, as long as the diameter of the orbit; canthus rostralis obtuse; loreal region very oblique and deeply concave; nostril a little nearer the eye than the end of the snout; interorbital space a little narrower than the upper eyelid; tympanum distinct, two thirds the diameter of the eye. Fingers obtuse, first not extending beyond second; toes obtuse, slightly webbed at the base; subarticular tubercles strong; inner metatarsal tubercle large, compressed, shovel-shaped, as long as the inner toe; a rather indistinct outer metatarsal tubercle. The tibio-tarsal articulation reaches the eye, the tarso-metatarsal the tip of the snout. Upper parts with symmetrical ridges following the arrangement of the spots; lower parts smooth. Pale greyish above, with dark brown symmetrical spots with darker and lighter edges; a light vertebral line, crossing a light cross-bar on the interocular space; a V-shaped light marking on the back of the head, the ends of the branches extending to the upper eyelids; loreal region blackish, with a light vertical bar between the eye and the nostril; limbs cross-banded; lower parts white.

From snout to vent 32 millim.

A single specimen.

LXXI.—On a new Mongoose from Matabeleland, British South Africa. By W. E. DE WINTON.

IN a collection of mammals lately presented to the British Museum by Mr. F. C. Selous, taken on his property Essex Vale, near Bulawayo, there is the skull of a hitherto undescribed form of *Cynictis*; the skin, unfortunately, was not obtained. I propose to name it, in honour of the collector,

Cynictis Selousi, sp. n.

Skull more elongated than *C. penicillata*, with the squamosal portion of the zygoma not so much expanded laterally; this process is only very slightly bowed upwards to join the malar, so that, viewed from the side, the lower edge of the zygomatic arch forms a straight line to the base of the infra-orbital foramen. The ascending process of the malar is very slight, running into a fine point, and barely meeting the post-orbital process. The back of the palate ends in a projecting point in the middle line; the pterygoid processes bow inwards, ending in small knobs. The auditory bullæ are considerably inflated, the posterior basal portion drooping below the plane of the anterior chamber.

Type in Brit. Mus. Collector's note:—"Skull of animal, probably killed and eaten by an eagle, found on grassy heap under a tree, Essex Vale, Matabeleland, 18th Oct., 1895" (*F. C. S.*).

In all measurements I follow Mr. Thomas in his monograph of the group (*P. Z. S.* 1882, p. 59).

Skull: basal length 76 millim.; greatest breadth 43; nasals, length in middle line 16, greatest breadth 8; inter-orbital breadth 18·5; intertemporal breadth 16·5; palate length 44, to cross-line 26·5; basicranial axis 26; basifacial axis 49; facial index 188.

Breadth outside postero-external angle of $\frac{p.4}{p.2}$ 25.

Teeth: $\frac{p.2}{p.1}$, horizontal length 4·1; $\frac{p.3}{p.2}$, length 4·5; $\frac{p.4}{p.3}$, external length 6·1, anterior breadth 5·5, greatest diameter 8·5; $\frac{m.1}{m.2}$, length 4·5, breadth 7·5; $\frac{m.2}{m.3}$, length 3·5, breadth 6; $\frac{p.3}{p.4}$, length 4·1; $\frac{p.4}{m.1}$, 6; $\frac{m.1}{m.2}$, 6; $\frac{m.2}{m.3}$, 5·5.

This is the skull of an adult animal with the teeth somewhat worn, the sutures of the nasal bones not perfectly closed. The size alone will distinguish it from the well-known form, and in shape the skulls are strikingly different, the new species having a narrower and more evenly oval skull than *C. penicillata*, viz. with the zygoma much less expanded in proportion to the face and brain-case. The breadth of the skull will be seen to barely equal the length of the palate, while in *C. penicillata* this measurement exceeds the length of the palate by about 5 millim. at all ages.

LXXII.—*Homology of the Anterior Segments of Ampharetidæ (Polychetous sedentary Annelids).* By M. PIERRE FAUVEL *.

THE anterior segments of the bodies of the Ampharetidæ appear to be difficult enough to homologize if one relies on the descriptions given by authors, for these are frequently contradictory. Malmgren† has distinguished in the species which he has described:—(1) a cephalic segment; (2) a buccal segment; (3) a naked segment; (4) a segment (according to him the third) which carries the paleæ in those species which are provided with these special hairs, as well as the first pair of branchiæ; (5) the first segment carrying the capillary hairs, followed by segments of like character. The branchiæ, to the number of four pairs (rarely three), are borne, according to the species, either solely by the fourth segment (third of Malmgren, *Melinna*), or by the fourth and the fifth (*Ampharetes*), or by the fourth, fifth, sixth, and sometimes by the seventh segments (*Amphiteis*). The first three segments may sometimes be invaginated on the fourth. This easily explains the errors of those authors who, having under observation only fixed and contracted specimens, have not recognized the presence of a segment behind the buccal segment. This error is least to be explained in the case of Claparède‡, who has overlooked this segment in *Amphiteis curvipalea*, which nevertheless he had alive under his hands. He only reckons a single achetous segment, and erects the absence of the second naked segment into the principal difference between *A. curvipalea* and *A. Gunneri*, Sars. Now, as we have been able to determine ourselves on several examples from Naples, this segment positively exists. The description of Claparède is, besides, erroneous, as well as his figure§. We have found *Amphiteis Gunneri*, Sars, at Saint-Vaast-la-Hougue in 1894||. Prof. A. Wiren has since been kind enough to send us specimens of *A. Gunneri* from the coasts of Sweden. We have thus been enabled to determine the complete identity of specimens from Naples, Sweden, and the Channel.

The species of Claparède founded on erroneous observations ought to disappear. The only difference consists in the absence, *not constant*, of a seventh tooth on the uncinal plates of

* From the 'Comptes Rendus,' 1896, tom. cxxiii. pp. 708-710.

† Malmgren, 'Nordiska Hafs-Annulater,' 1865.

‡ Claparède, 'Annélides du Golfe de Naples,' Supplément, 1870.

§ Lo Bianco, 'Gli Annelidi Tubicoli trovati nel Golfo di Napoli,' 1893.

|| P. Fauvel, "Sur la Présence de l'*Amphiteis Gunneri* sur les côtes de la Manche" (Bull. Soc. Linn. de Normandie, 4^e série, 9^e vol., 1895).

the last segments of the abdomen. As to the curvature of the paleæ, it is equally variable in individuals according to their place of origin. The anterior segments, then, are quite homologous in the Ampharetidæ; there remains the question of the branchiæ. Are these appendages borne by different segments according to the species? May one segment bear, sometimes one, sometimes two, three, or even four pairs of branchiæ? The anatomy of the circulatory apparatus will furnish us with an answer.

In *Ampharetes Grubei* the branchiæ appear to be thus arranged:—three pairs on the fourth segment, which also carries the paleæ; one pair on the fifth segment (first setigerous segment). The branchiæ receive the blood of the heart by a distinct vessel. The heart gives off four vessels on each side. This is a presumption in favour of the opinion that a pair of branchiæ exists for each segment, but is not a proof. This proof we shall find in the disposition of the efferent vessels. In fact, if we examine the ventral vessel from before backwards, we see that this vessel bifurcates in front into two branches going to the œsophagus; behind this bifurcation it gives off on either side a transverse branch which goes to the first branchia. This vessel arises from the ventral vessel in the fourth segment, in front of the diaphragm which separates the fourth segment from the fifth. The fourth pair of branchiæ, in spite of its apparent insertion on the fifth segment, really belongs to the seventh by the origin of its efferent vessel. But here a complication presents itself; this efferent vessel, on leaving the branchia in front to reach the ventral vessel, anastomoses with a great lateral trunk, which stretches along the whole length of the animal from the seventh segment as far as the posterior segment. This trunk is formed by a series of anastomoses passing from one parapodium to another. The blood, returning from the fourth branchia, passes in small quantity only to the ventral vessel, the major portion of it being thrown into this anastomotic trunk. The first branchia is that of the middle of the anterior row, the second is the most external of the same row, the third is the most internal, and the fourth is that of the second row, situate just behind the first. In *Amphicteis* the study of the circulation demonstrates equally that the branchiæ belong to the fourth, fifth, sixth, and seventh segments. The fourth branchia communicates in *Ampharetes* with a lateral anastomotic trunk; but the heart only gives origin to three trunks on each side. The first of these trunks bifurcates to supply the first two branchiæ, as Wiren has already figured it*; and it is this which has led this author to

* Wiren, 'Our Cirkulations- och Digestions-Organen,' 1885.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
<i>Ampharetes</i> .				{ Paleæ. Do. 1st branchia.	1st foot. Do. 2nd branchia. 1st nephridium.	2nd foot. Do. 3rd branchia. No nephridium.	3rd foot. 1st pinnule. 4th branchia. 2nd nephridium.	4th foot. 2nd pinnule. Do. Do.
<i>Amphicteis</i> .				{ Paleæ. Do. 1st branchia.	1st foot. Do. 2nd branchia. 1st nephridium.	2nd foot. Do. 3rd branchia. 2nd nephridium.	3rd foot. Do. 4th branchia. 3rd nephridium.	4th foot. 1st pinnule. Do. 4th nephridium.
<i>Melina</i> . . .				{ Spiny hair. Do. 1st branchia.	1st foot. Do. 2nd branchia. 1st nephridium.	2nd foot. Do. 3rd branchia. 2nd nephridium.	3rd foot. 1st pinnule. 4th branchia. 3rd nephridium.	4th foot. 2nd pinnule. Do. 4th nephridium.
<i>Sanytha</i> . . .				{ 1st foot. Do. 1st branchia.	2nd foot. Do. 2nd branchia. 1st nephridium.	3rd foot. Do. 3rd branchia. 2nd nephridium.	4th foot. 1st pinnule. 4th branchia. 3rd nephridium.	5th foot. 2nd pinnule. Do. 4th nephridium*.

* Travail fait au Laboratoire maritime de Tatiou, en octobre 1896.

consider the four pairs of branchiæ as issuing from three segments only. In certain individuals one recognizes distinctly, even from the outside, this insertion on four segments: the first is on the fourth segment, the second on the fifth, the third on the sixth, and the fourth also on the sixth, but abutting a little on the seventh. In *Melinna*, on the contrary, the four branchiæ of each side arise from a common mass inserted on the fourth segment; but nevertheless each branchia has its efferent vessel corresponding to a distinct segment. A glance at the beautiful figures of Meyer * will suffice to carry conviction on this point.

By combining my observations with those of Meyer and of Wiren I have compiled the table given on p. 472, which shows the homology of the anterior segments of the Ampharetidæ.

LXXIII.—*On the Habits of Evania Desjardinsii, Blanch.*

By M. EDMOND BORDAGE †.

SOME months ago I collected in the Island of Reunion a certain number of oothecæ of *Blatta*, in the hope of seeing the parasites of the family of Chalcididæ emerge from them. A few days afterwards I was greatly surprised to notice in the glazed box which contained the oothecæ a hymenopterous insect, measuring 7–8 millim., of a black colour, and having no relation whatever with the family of the Chalcididæ.

At the first glance the insect seemed to have the abdomen atrophied or mutilated. I recognized later, after an examination of its principal characters, that I had to deal with an *Evania*—abdomen short, pediculated, laterally compressed, inserted into the back of the metathorax; antennæ filiform and as long as the body; lastly, the neurulation of the wings was entirely that of the genus *Evania*. The resemblance to a species found in France—*E. appendigaster*—caused me at first to believe that it was a representative of this species; but on examining more closely the rudimentary abdomen, I found it to be compressed laterally, but a little more rounded than that of *E. appendigaster*, which is distinctly triangular. A search in books taught me at length that the species which interested me was *E. Desjardinsii*, described by M. Émile Blanchard (Hist. nat. des Insectes, t. i. p. 299). This species, found in the Ile de France, had not yet been found in Bourbon, and the Natural-History Museum of Saint-Denis did not possess a specimen.

* Meyer, 'Studien über der Körperbau der Anneliden,' 1886–1887, fig. 3, pl. xxii., and fig. 3, pl. xxiii.

† From the 'Comptes Rendus,' t. cxxiii. pp. 610–613 (1896).

After having announced in this island the presence of an entomological species hitherto unknown, and which, perhaps, has been introduced there from one of the two other Mascareignes in relatively recent times, I am pleased to be able to make known certain remarkable details as to the habits of the *Evanie*. The perfect insect lives upon plants, but the larva is parasitic. According to some authors—Reid, Dr. Arnold (cited by Kirby and Spence, *Introd. to Entom.* vol. i. p. 580, and vol. iv. p. 216)—this larva is parasitic on the *Blattæ*. It is difficult to suppose that the egg which gives birth to the parasite can be introduced into the body of the *Blatta* when this latter has undergone all its metamorphoses; the teguments of the Orthopter would certainly be too resistant for the ovipositor of the *Evania* to penetrate them. It is even probable that this feeble instrument would find great difficulty in forcing its way between two segments of the body of the *Blatta*. One is therefore forced to admit that the introduction of the egg takes place when the Orthopter is still in the larval or nymph state (immediately after each change the body is white and soft). Maybe that these events take place in this manner with certain species of *Evania*; but I strongly believe that the observations of MacLeay, Lewis, and Stephens (quoted by Westwood, *Trans. Ent. Soc.* vol. iii. p. 240) are more exact, and that in a general way the young *Evanie* live as parasites in the oothecæ of the *Blattæ*. At least, this is the case with *E. Desjardinsii*. This species, which measures from 7–8 millim. after its complete development, undergoes all its metamorphoses in the interior of an ootheca 12–15 millim. in length, belonging sometimes to *Blatta americana*, sometimes to *B. maderæ*. The larva does not weave any cocoon properly so-called; it contents itself with secreting a few threads of greyish silk of rather coarse texture, applied to the wall of the ovarian capsule. This silk isolates the larva from the small debris arising from the destruction of the partitions of the ootheca.

Recently I have been able to observe *Evanie* penetrating into houses. They are probably in search of the oothecæ deposited by *Blattæ* in dark corners; but, despite all my care, I have never been able to catch them in the act. I have only once seen *E. Desjardinsii* follow a *Blatta*; this was in the June of this year in the botanic garden of Saint-Denis. The Hymenopter flew round and round a female *Blatta americana*, whose ootheca, still soft and whitish, protruded from the extremity of the abdomen. The Orthopter, half-blinded by the brilliant light, fled before the aggressor, and succeeded in taking refuge in a crack which presented itself in the bark of a tree; this put an end to my observations, of

which the final result interested me intensely. In spite of this, I am convinced that the *Evania* intended to introduce an egg into the ovarian capsule still carried by the *Blatta*.

An author quoted by Westwood (*loc. cit.*)—Mr. Stephens—seems disposed to admit that each species of the genus *Evania* is parasitic on a single species of *Blatta*, whilst the converse would not be true—that is to say, that a single species of *Blatta* would have as parasites two species of the genus *Evania*. Relying on the fact that *E. minuta* and *E. fulvipes* are abundant in the parts of Europe inhabited by *Blatta lapponica*, he regards them as indigenous, whilst, according to him, the typical species *E. appendigaster*, which frequents *B. (Periplaneta) orientalis*, disseminated by commerce throughout the world, ought to be considered as imported with this Orthopter.

If in so concluding Stephens had the intention of formulating a general rule, the example of *E. Desjardinsii* doubly weakens it, because (1) this *Evania* is parasitic on at least two different species of the genus *Blatta*, (2) neither of these species is peculiar to the Mascareignes. We ought to conclude, following Stephens, that *E. Desjardinsii* is tropical American in origin, because *B. americana* is such, or that it comes from the same region as *B. maderæ*—two inadmissible suppositions, since the *Evania* in question is peculiar to the Mascareigne Islands. It is, however, right to recognize that, if this rule is actually at fault, it is in origin partly correct. In fact before the introduction of *B. americana* and *B. maderæ*, *E. Desjardinsii* ought to have been the parasite of one or more *Blattæ* belonging specially to the fauna of the Mascareigne Islands. Perhaps even this *Evania* is still parasitic on this species—or these indigenous species, among which I may mention *Blatta corticum* and *B. cinerea*—which measures as much as 28 millim., and whose ootheca ought to be of considerable size.

Actually, and in a general way, it appears rational to look rather for a relation between the figure of the *Evania* and the ootheca of the corresponding *Blatta*. The larva of the Hymenopter must find in the ovarian capsule space for development, and, above all, a sufficiency of food. We can understand that, the second condition being fulfilled, the first is not absolutely indispensable, because in the case in which, at a given moment, the dimensions of the ootheca become insufficient, the larva could escape from its asylum, weave a cocoon, and then complete its metamorphosis.

There remain several important points in the habits and development of *Evania Desjardinsii* to be worked out; I hope to be able to do this shortly.

LXXIV.—The "Claims of Priority," and what they are sometimes worth. By F. JEFFREY BELL, M.A.

READERS of the 'Annals' may remember that some time since I took the case of the name "*Holothuria*" as a test-case for the claims of priority*. No priority-claimer apparently had discovered that no *Holothurian* ought to be called by the name *Holothuria*, and I refused to take up a position which, on this occasion, courtesy forbids me to characterize.

A little later my lamented friend George Brook took up an attitude similar to mine with regard to the well-known name *Madrepora*†.

In 1893 there appeared in the 'Athenæum'‡ a warmly appreciative notice of Mr. Stebbing's courage in altering the Latin names of the common crayfish and the common lobster. I regretted both the praise and the "courage;" but the garden I had then to cultivate was big enough for me, and I had no wish to be led into strife.

Now, however, I find I have to name for exhibition in a public gallery both a lobster and a crayfish.

In his 'History of Crustacea' (1893, p. 202) Mr. Stebbing applies the name Leach and the date 1814 to the term *Astacus*, and states that the type species is *Astacus gammarus*; a little later (p. 207) he writes "*Potamobia*, Leach, 1819, . . . is the genus that has so commonly of late years been called *Astacus*."

Leach's genus *Astacus*, in 1814, contained two species—*A. gammarus* and *A. fluviatilis*. The former stood first, and is therefore, I presume, regarded as the "type species"; on this I would remark that the generic name *Astacus* was invented by Gronovius in 1764 and that his first species is clearly *Cancer fluviatilis* of Linnæus.

Now as to *Potamobius*: in 1818 Leach§ gave a "liste exacte des noms de tous le genres de crustacés qui ont été publiés jusqu'à ce jour"; among them is *Potamobie*. I am no bibliographer, and I do not know when this name first appeared, and I do not know to what species its author (whoever he was) applied it; but it is quite easy to know what contemporary writers thought about it. Desmarest, who quotes Leach on almost every page, says||:—"Il est probable que ce genre (*Thelphusa*) diffère peu, ou ne diffère pas, de ceux qui ont été nommés *Potamon* par M. Savigny, et *Potamobia* par M. Leach." Prof. Huxley does not give the

* viii. (1891) p. 108.

† Cat. Corals Brit. Mus. i. p. 3.

‡ 1893, i. p. 800.

§ Dict. Sci. nat. xii. p. 75.

|| *Op. cit.* xxviii. (1823) p. 246.

source of his information, but it is clear * that he was acquainted with the fact that *Potamobius* was preoccupied before 1819, when Samouelle, basing himself on Leach's MSS., proposed to apply that term to *Astacus fluviatilis*.

To draw the conclusions that flow from these facts:—

First, as a matter of accuracy in dates and names: on p. 202 of Mr. Stebbing's work already referred to, "*Nephrops*, Leach, 1819," should have the date corrected to 1814; "*Astacus*, Leach, 1814," on the same page, should be altered to—well, it is hard to say; Leach's *Astacus* of 1814 is the *Astacus* of Gronovius (1764) as emended by Fabricius and others, and by Leach's removal of *A. norvegicus*. "*Potamobia*, Leach, 1819" (p. 207), should read *Potamobius*, Samouelle, 1819 [preocc. by Leach].

Secondly, till the appearance of the second vol. of Milne-Edwards's great work in 1837 zoologists at large were content to accept as accurate the words of Desmarest in 1823 †:—"dans l'état actuel de la science, le genre Ecrevisse [*Astacus*] se trouve renfermer des espèces d'eau douce et des espèces marines dont le nombre ne s'élève pas à plus de six."

All, then, that the most pious priority-purist could ask is that, in the year 1896, some one should invent a name to replace Samouelle's preoccupied term *Potamobius*, given by him in 1819 to the crayfish, and, as a reward for doing so, he promises only that the inventor will throw into confusion not only carcinological literature, but every text-book in every language under the sun.

I have taken a great deal of trouble with this case, and I have a suspicion that if a few more would be equally "eingehende" we might speedily give the purists the short shrift I have often wished them.

BIBLIOGRAPHICAL NOTICE.

Artistic and Scientific Taxidermy and Modelling.

By MONTAGU BROWNE, F.G.S. &c. London, 1896.

SOME years ago Mr. Browne published a very useful little work called 'Practical Taxidermy,' and we have now before us a much more complete and carefully compiled work on the same topic, which goes more fully into the subject. Mr. Browne enters in some detail into the origin and process of the art from the earliest ages unto the present time, from which we gather that, though the Egyptians preserved various kinds of animals by embalming them, yet the actual stuffing of specimens for museum purposes does not date back more than about three hundred years; but even within

* P. Z. S. 1878, p. 752.

† *Tom. cit.* p. 307.

the present century stuffed specimens in most museums were far from resembling the living animals, and it is only somewhat recently that care has been taken to copy nature as closely as possible.

We are glad to see that Mr. Browne gives the late Mr. E. T. Booth, of Brighton, the credit which is due to him of being the first to start a museum in which the birds were mounted surrounded by accessories closely copied from nature—an example that has been followed not only by the Natural History Museum at South Kensington, but by many other provincial museums in England and also abroad.

A full list of instruments he considers necessary is given, together with illustrations; but a first-class workman would, we think, be able to dispense with several of those named, and, as far as skins of birds are concerned, we have seen first-class specimens which have been made with no tools beyond a pocket-knife and a pair of stout nail-scissors. A useful chapter follows on preservatives, from which we observe that he objects to arsenical paste, which, he contends, does not protect the specimens from the larvæ of moths or beetles; and he recommends in its place a non-poisonous preservative soap consisting of chalk, soap, lime, and musk. Concise and careful directions are given of how to prepare skins and to mount specimens, and, as regards bird-skins, we have found Mr. Maynard's plan of wrapping a freshly prepared skin in a layer of cotton wadding to be the best mode, especially when the skins have to be packed at once. Full directions are also given for the modelling of rocks, trees, &c.; and respecting this we may say that we have found light peat most useful in the reproduction of rock-work, and have been able to make a very close copy of a natural piece of rock with it.

At the end of the book a carefully compiled bibliography of the works on the subject is given, and we are glad to see that Mr. Browne has made judicious use of most of them, especially those published in the United States, in the body of the work.

Mr. Browne is evidently a first-class taxidermist and well able to write with authority on the subject; and we can safely recommend the work to any one interested in the preparation of specimens. Some very good illustrations are scattered through the work, twenty-two of which are printed separately and eleven are printed in the text.

MISCELLANEOUS.

The Evolution of Lithocystis Schneideri, a Parasite of Echinocardium cordatum. By M. LOUIS LEGER.

I HAD recently the opportunity of collecting, on the beach at Wimereux, a considerable number of *Echinocardia*, all of which contained *Lithocystis Schneideri*. I availed myself of it to study the evolution of this singular parasite, concerning which opinions are so divided, some regarding it as a Myxomycete, others as a pure

cœlomic form, others as an aberrant sporozoarium. The general aspect under which this parasite is actually known has been described by M. Giard, who discovered it in 1876. It consists of plasmodial masses of a blackish or violet colour, irregularly applied to the internal face of the test of the sea-urchin and enclosing spherical cysts containing numerous spores, appendiculate and with falciform corpuscles. Each cyst encloses besides a central spherical mass of tiny crystals of calcic oxalate.

Before seeking the origin of these cysts, I examined carefully the liquid of the cavities of a great number of sea-urchins, and I discovered in a great number of them monocystid Gregarinidæ, solitary or conjugated, free in the liquid. On continuing the investigation I succeeded in finding the various intermediate stages between the phase of young monocystid and the crystalline cysts of *Lithocystis*; in fact the gregarinid origin of these cysts was established.

The free gregarinid is difficult to see, especially when it is young, because it is not common and often concealed in the convolutions of the digestive tube. It is cylindrical in form, attenuated at the poles, and shows a beautiful striated contractile layer, with a large nucleus and a spherical nucleolus. The conjugate forms are easy to see from their size, their extremely active and complicated movements, and their curious method of copulation. The adult gregarinids measure more than 1.5 millim., so that they are readily distinguishable by the naked eye. In the conjugation, the attachment is not made between poles of the same or opposite name, as in the known forms, but by a small surface situate at about equal distance from the two extremities of the individual, as, for example, in *Diplozoon paradoxum*: this mode of conjugation, so far as I know, has never been observed in the Gregarinidæ. When the moment of encystment approaches, the two individuals take on a more massive form and their movements become gradually slower. It is at this period that the crystals are formed which are found later in the ripe cysts. To this end there appear on each individual numerous spherical clear vacuoles, in each of which a single crystal is formed, of the clinorhombic type, which appear to me, so far as microchemical analysis will show, to consist of calcic oxalate. When the encystment is complete, and the divisions of the nucleus and the protoplasm, which are to give origin to spores, begin to be effected, the vacuoles disappear and the crystals unite to form a common sphere in the centre of the cyst. These crystals, which appear at the beginning, in a kind of excretory vacuoles, ought, I think, to be regarded as a veritable excretory product of the gregarinid, a product which, having become useless or even a hindrance to the division of the protoplasm, is separated from the rest of the creature at the moment of reproduction. The presence of this product in the interior of the gregarinid is not at all surprising when one considers that the fluid in the general cavity of the *Echinocardium* contains a large proportion of salts of lime; it ought to be found in all the cœlomic gregarinids of Echinoderms with a calcareous test—a fact which I have already verified for *Spatangus lividus* from the

Mediterranean, in which I have found a new form of *Lithocystis*. The formation of crystals is not the sole interesting phenomenon which characterizes the evolution of this singular gregarinid. In fact at the moment when the gregarinids, closely attached and almost motionless, begin to encyst, the amœbocytes of the liquid in the cavity of the sea-urchin attach themselves closely to their surface and form a network with dense meshes, each of them putting out a free pseudopodium on the exterior directed normally to the surface of the cyst. All the pseudopodia are rigid and of equal length: this gives to the cyst a bristly appearance, very peculiar and at first sight very difficult to explain; but the cause is no longer in doubt when by a very slight compression of the cover-glass a great number of the phagocytes leave the surface of the cyst and form in its neighbourhood an elegant network by the anastomosis of their pseudopodia.

Afterwards the amœboid cells are crammed with pigment granules, take on an elongated form, and finally enter into a state of degeneration, forming blackish masses of plasmodial appearance, which surround the greater number of the cysts. Such is the origin of the supposed plasmodia of *Lithocystis*, in which an attentive study shows the amœbocytes in all stages: young, very active, with a well-marked nucleus; others already deformed and filled with pigment, the greater portion completely granular and degenerated. The parasitic product which is known under the name of *Lithocystis* is therefore complex. The cysts are those of a monocystic, cœlomic gregarinid of normal evolution, and the crystals are an excretory product; the coloured plasmodial masses are made up of a collection of the phagocytes of the *Echinocardium*, of which the greater part are dead and charged with granular pigment. By the form of its spores, the *Lithocystis* falls naturally into the family of the Urosporidæ, alongside the genera *Urospora* and *Ceratospora*, of the general cavity of the Siphunculidæ and the Synaptidæ.—*Comptes Rendus*, 1896, tom. cxxiii. pp. 702-705. (Studies from the Laboratory at Wimereux.)

On a Viviparous Ephemera. By M. CAUSARD.

Viviparity is a condition relatively rare among insects. In fact it is only observed among the Strepsiptera, and exceptionally in the three orders of Hemiptera, Diptera, and Coleoptera. Among the first, many of the Aphidæ and the Cochinellidæ are viviparous for the parthenogenetic generations. Among the Diptera, the Pupiparæ, certain Muscidæ (*Tachina*, *Sarcophaga*), and several Cæstrids parasitic on mammals: the pædogenesis of the larval forms of *Cecidomyæ* is also accompanied by viviparity. Lastly, among the Coleoptera there are only known certain Staphylinidæ which live as parasites in the ant-hills of South America (*Spirachtha*, *Corotoca*).

One would certainly not expect to encounter viviparity among the Ephemera, which have the reputation of living but a very short time in the adult state, a few hours at most, in certain species.

According to observers, these insects, as soon as born, copulate;

then the females lay eggs rapidly and soon die. This short existence is incompatible with the development of the embryo in the maternal organism. Nor is this rule general: I have studied recently a species of the Ephemeriæ in which an entirely different state of things prevails; this is *Chloeopsis diptera* (Latr.). This species is very common in houses at the end of summer and the commencement of autumn, when these insects attach themselves to the windows or the ceilings, and there rest immovable, their two wings turned back and applied one against the other, the posterior part of the abdomen terminated by two long filaments, turned back upon the dorsal aspect. The same insect may be observed in the same place for several days. Having captured a large number of them, I have been able to keep them for more than three weeks before they laid their eggs. I have found it impossible to fix exactly the duration of their existence, because at the time of capture I did not know how long they had emerged from the nymph state. However that may be, there are Ephemæræ which have but little title to the name. This relatively long existence in the adult state is in accord with their processes of reproduction.

Desiring one day to study the circulation of the blood in one of these insects, in the living state, which I supposed to be sufficiently transparent for the purpose, I took one of them and placed it between two plates of hollowed glass. The pressure of these plates caused a quantity of greyish matter to exude from the abdomen of the animal; I regarded the insect as dead and my observations a failure. Nevertheless, on examination with the microscope, I observed that the extruded matter was formed of a great number of little ovoid bodies, which immediately began to move about and unroll themselves. Each of them was a little larva, which was very active and began to swim about. Were these Ephemæræ viviparous? This was the question that I at once asked myself. Then I examined the contents of a large number of individuals, and I found eggs in every stage of development: in some the segmentation was but slightly advanced, but a commencement of evolution was very distinct; in others, the extruded larvæ showed segmentation; the most advanced enclosed completely developed larvæ, but still enclosed the transparent membrane of the egg. I have since been able to observe the females emitting their larvæ freely without any pressure, so that their viviparity is a proven fact. When the moment approaches that the insects seek the water, they allow themselves to fall into it and float on the surface, with their wings extended, up to the moment at which the larvæ are extruded. During this operation, which lasts for a very short time, the whole of the last three segments of the abdomen are lifted upwards so as to form almost a right angle with the rest of the body. The larvæ are expelled by a double orifice pierced between the seventh and the eighth abdominal rings; these two openings are only separated from one another by a very slight portion of tissue, and generally break into one another so as to become one after the deposition of the eggs; there results a large slit, which involves the whole of the lower half of the line of junction of these two rings. In this case

the digestive tube is burst, so that the nerves are detached behind the last nervous ganglion which occupies the seventh abdominal ring. These observations led me to study the female genital apparatus, which ought to be constructed with a view to the internal development of the eggs. Almost the whole of the body of the female is occupied by two huge sacs attached, the one to the other, along the middle line; the vertical partition which separates them is traversed by numerous tracheæ. These sacs extend over the whole abdomen, with the exception of the last two segments, and reach as far as the head, occupying in the three thoracic rings almost the whole of the space left free by the muscles of the wings and legs. Beneath them is the digestive tube, reduced to a canal with a thin and delicate wall, and the nervous chain. These two sacs open on the outside, each by a distinct orifice pierced in the membrane which joins the seventh abdominal ring to the eighth, and, as already described, at the moment of the exit of the larvæ these two openings run together to form one. To what part of the genital apparatus of other insects does this double incubation sac correspond? I have not yet been able to settle this point, inasmuch as I have only had under observation insects in which the sacs were already filled with eggs in course of development, and in which the empty and shrivelled ovaries were with difficulty visible. In spite of the relatively long duration of their life, the *Chloecopes* take no more food in the adult state than the other Ephemera. Their mouth is only armed with a few soft and incomplete parts.

The larvæ are elongated, very active, armed with feet terminated by a single hook. The head, roughly pentagonal in form, bears two long antennæ and five ocular spots, of which one, odd, is situate between the bases of the antennæ; the four others are arranged in two pairs, of which the posterior furnishes the reticulated eyes of the adult. The mouth is provided with a masticatory apparatus, which is well formed. The abdomen is formed of ten segments, of which the last bears two long filaments provided with a few stiff hairs. The length of the body is 0.7 millim., not including the caudal filaments, which are at least as long as the body. The cephalothorax and the anterior part of the abdomen contain at birth brilliant globules, which disappear in a day or two. During the first period of their existence the larvæ have neither tracheæ nor tracheal branchiæ. Six days after their birth the larvæ undergo a first change: their appearance changes but little, but on each of the 2nd, 3rd, 4th, 5th, and 6th abdominal rings there appears a pair of short prominences, each as much developed as the others, the rudiments of the future tracheo-branchiæ. Three days later there is another change: the five prominences just mentioned become elongated, and a pair of them appear on the first abdominal ring; the tracheæ also become visible. After the third change, the five pairs of tracheo-branchiæ are well-formed and receive the tracheæ. Those of the first ring do not develop completely until the fourth change, and, finally, those of the seventh abdominal ring, apparent at the third change, are not complete till after the fifth. From that time the larva possesses all its organs. I hope to be able to pursue these investigations up to the adult stage.—*Comptes Rendus*, 1896, tom. cxxiii. pp. 705-708.

Determination of the Directing Element in the Jaws of Insects.

By M. JOANNES CHATIN.

In a previous series of researches, the results of which I have submitted to the judgment of the Academy *, I have studied the variations which the jaws can present, not only in their *ensemble*, but in the parts of which they consist, when studied in boring-insects. For the purposes of such investigations these represent the fundamental types; remaining always near to its initial state, the jaw permits of the accurate recognition of the smallest details as to the development, relations, &c. of its different parts.

Highly instructive for all that relates to the descriptive anatomy of the organ though the boring-insects ("insectes broyeur") are, they become insufficient when it has to be considered from the point of view of philosophic anatomy.

Among other questions in this connexion there is one which has been generally left in the shade. The theory of Savigny has traced in its broad lines the series of transformations which the jaw undergoes in order to adapt itself to the varying mode of life of insects. But what is the rôle to be assigned to the different parts of the jaw in its numerous functional adaptations? Ought they to play an equal part, or should one of the parts be pre-eminent? should it reduce the others to the position of satellites or assert itself as the centre of the curious processes which so strangely metamorphose the organ?

After a minute analysis, the question cannot be elucidated except by varying within wide limits the types on which it is proposed to determine which is the directing element of the jaw.

It is easily settled when one passes from the Borers to the Hymenoptera. According to a too widely spread opinion, their jaw would always take on the character which it presents in the Apidæ, in which its appearance differs profoundly from that in the Borers. There is nothing so baseless as this generalization; in reality the form proper to the Borers reappears in several genera (*Vespa*, *Microgaster*, &c.). The base of the organ is formed by a submaxilla, above which rises the maxilla, figuring as the central limb of the jaw; on its upper part it displays three appendages, among which the palp is far the most developed, the two others (galea and intermaxilla) appearing to be still secondary.

In *Gonatopus*, *Xyphidrina*, and *Bracon* it is seen that the galea increases progressively, at the same time that the intermaxilla approaches it more and more closely.

In the genus *Perilampus* the formation of a mixed galeo-intermaxillary plate may be seen. This is definitely constituted in *Cephus* and *Megachile*, much elongated, absorbing, so to speak, the intermaxilla; the galea is transformed into a powerful blade, which becomes henceforth the principal part of the jaw.

Here, then, is an organ completely modified, in no way resembling what it was in the Borers, tending, on the contrary, to the form presented by the Suckers, such as the Lepidoptera &c.

I could pass at once to the examination of these latter, but it

* 'Comptes Rendus,' 1879-1887, and 'Concours pour le Grand Prix des Sciences physiques,' 1885.

appears to me preferable to unite them to the preceding insects by an intermediate group, that of the Phryganidæ. Without discussing their multiple affinities, without recording the retrogression which their buccal organs undergo, I believe it necessary to insist on the arrangements peculiar to their jaws.

The somatic part corresponds, not to the maxilla, which is confined to the base of the organ with the submaxilla, but to the galea completed by a slender intermaxilla—a fresh manifestation of the tendency sketched in *Cephus*, *Megachile*, &c. The galea appears as the directing section of the jaw, and this idea is still further accentuated in the following groups.

As far as the Lepidoptera are concerned, Savigny has shown that their proboscis is the result of the union of the two jaws; all opinions to the contrary have been shown to be untenable. But what is the mode of constitution of the jaws so transformed? What part does each portion of the maxillæ play in the construction of this singular apparatus?

Observation shows that all the acting part of the organ arises from the galea. Its base comprises the submaxillæ and the maxillæ; greatly reduced and thrown back upon the sides of this base, the palps take no part in the formation of the trunk properly so-called.

If one examines a maxillary stylet in the Hemiptera, one is struck by its likeness to the mandible of a butterfly. In the two cases the base corresponds to the same parts; the lamellar region (channelled, excavated, setiform, &c.) is essentially galear; it is easy to supply a demonstration of this, and certain Cicads especially lend themselves to it.

So for the Diptera, the types to be studied must be suitably chosen. If we begin with the group of the Muscidæ, as one usually does, we are immediately brought face to face with difficulties which will explain the divergences. They disappear when we consider another family.

The Eristalidæ should be mentioned as especially offering forms which link with the previous ones in establishing from another side the passage to the singular mandibles of the Diptera, considered as the most aberrant in this respect. I limit myself to a *résumé* of the arrangements presented by *Eristalis tenax*. On a base cleft in two places there is inserted a tiny palp and a long blade, the latter giving to the mandible its general configuration; it represents the galea, to which the intermaxilla is joined.

So, in the Tabanidæ, the Culicidæ, &c., one recognizes the pre-eminence of the galea, so secondary when one confines one's study to the Borers. The exclusive study of these latter conduces to the view that the maxilla is the fundamental portion, whereas nothing could be more inexact. Morphographical analysis shows, in fact, that the maxilla undergoes a true regression, whilst the mandible acquires a new functional importance. This finds expression in certain tendencies, proving progressively:—(1) elongation of the galea; (2) fusion of the intermaxilla with the galea; (3) reduction of the palp.

Thus a double organic balance shows itself: the maxillary region

decreases in proportion as the appendicular region develops; further, in the former the palp and the intermaxilla dwindle as the galea (the sole directing portion) enlarges.

These facts seem to be of such a character as to modify the classic conception of the mandible; further, they permit a rapid extension to other buccal organs. Such is the object of the researches on which I am at present engaged, and of which I hope to give the further results in a later communication.—*Comptes Rendus*, 1896, tom. cxxiii. pp. 608–610.

On the Hibernation of Clavelina lepadiformis, Müller.

By MM. A. GIARD and M. CAULLERY.

Clavelina lepadiformis, Müller, formerly somewhat rare on the coasts of the Pas-de Calais, is become very abundant on the Bernard rocks, near Boulogne, since the establishment of the new port. To any one who observes the pretty corms of this Synascidian it is a very interesting problem to know how it is that the colonies, sometimes as large as the fist, disappear entirely in the winter, to reappear in the month of June in the following year, with the same development and in precisely the same positions. One cannot attribute the formation of these new corms to the proliferation of the oozoites produced by the old ones, because, rapid though the budding of these oozoites may be, it could not suffice to produce such large masses in so short a time. But if, towards the end of September or in October, or even during the equinoctial tides of the spring of the following year, one examines carefully the place occupied by the vanished colonies, there will be found adhering to the rocks numerous ramified and interlacing stolons, bearing here and there little whitish glomeruli of a chalky appearance, the whole constituting an *ensemble* which recalls well enough the general aspect of a colony of Bryozoons of the genus *Bowerbankia*. It is the form under which the *Clavelina* hibernates, reduced to tubular stolons filled at certain points with reserve material.

Nature of the Stolons.—The stolons in which the reserve material is accumulated are identical with those which during the summer unite amongst themselves the different individuals of the corms, and on which are formed the ordinary blastozoites. They arise from the lower part of the abdomen of the individuals. Often they climb to the surface of these, and not infrequently the tunic of the stolon is so united as to be continuous with that of the individual. As, on the other hand, the stolons divide themselves into sections, one often sees isolated fragments of them crammed with reserve material, forming part at certain points with the tunic of individuals of which the branchia and digestive tube have more or less completely disappeared.

Like the normal stolons, the hibernating stolons enclose a prolongation of the epicardiac tube (“cloison stoloniale”), of which the two faces are fused.

Modifications of the Stolons.—At certain points more or less regularly interspaced the stolonial tube produces numerous lateral digitiform diverticula, forming the whitish glomeruli in which the reserves are accumulated, and which may be compared with the *gemmules* of sponges and the *statoblasts* of the Bryozoa. On these

glomeruli the exoderm of the stolon is rapidly modified. Instead of being very thin and flattened, it becomes cylindrical. The nuclei are usually on the internal face. The reserve material, in the form of white opaque granules, and staining with carmine, is arranged, on the contrary, on the external face. The reserve granules are essentially different from excreted pigments, white or yellow, which form the ornamental lines on different parts of the bodies of the *Clavelinæ*. In the lumen of the stolon there is found a mass of cellules which ought to be regarded as phagocytes, from the mesenchymatous elements arising without doubt from the mesoderm of the former animals of the colony. Many of these mesenchymatous cellules also enclose reserve material, always under the form of white granules, occupying in the protoplasm the vacuoles which are generally blended into one large central vacuole; the protoplasm and the nucleus are thrust out to the periphery. The cellules so modified can agglomerate, and they end by blocking up the greatly distended stolon. Although these cellules appear to multiply actively, we have never been able to observe mitotic figures. The epicardiac partition presents no modification; it is always very thin and the two leaves remain joined. After a certain time the stolons divide into sections completely isolated one from another; each new section presents numerous digitations. These various fragments always possess a portion of epicardium.

Further Evolution of the Sections.—The sections so isolated may remain for a longer or shorter time without evolution, according to the surrounding conditions. The development of the buds first shows itself by the change of aspect of the fragment of epicardium. The epicardiac cells proliferate energetically by karyokinesis and become strongly colourable. They soon form a hollow vesicle, comparable to the internal vesicle of the normal buds of Synascidians; though we have not followed step by step the transformations of the vesicle, we do not doubt the homology of its ulterior development with that of the ordinary blastozoites of *Clavelina*. From the beginning of this process there is a rapid disappearance of the reserve material accumulated in the exoderm. The height of the epithelial cells diminishes in proportion as the cells multiply and empty themselves of their reserve material. The reserve material of the mesenchymatous cells disappears equally by digestion proper without the intervention of foreign elements.

Summary.—*A.* The reconstitution of the corms of *Clavelina*, after winter, is accomplished by a process of budding homologous with the normal process of budding.

B. The accumulation of reserves in the form described above is to be met with in the colonies collected in July. It is exaggerated in proportion as the sexual reproduction diminishes (August and September), and attains its maximum in autumn, when the old individuals of the cormus, first reduced to their tunic of cellulose, have finally disappeared.

C. It ought, then, to be interpreted as a normal physiological arrangement, permitting the latent life of the cormus during a certain time. It is a process of hibernation comparable with that which we have already described in the Polyclinidæ.—*Comptes Rendus*, 1896, tom. cxxiii. pp. 318-320.

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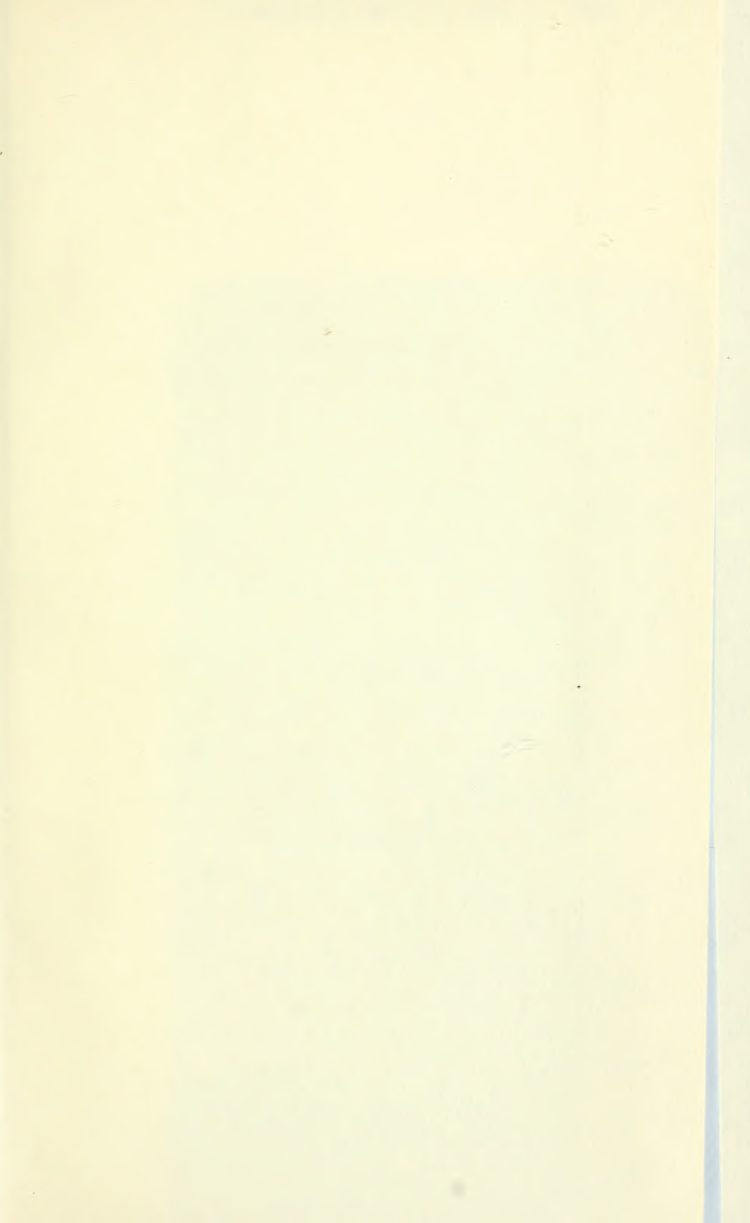
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